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MEMORANDUM

SUBJECT: Revised EFED Risk Assessment for the Reregistration Eligibility Decision on 5-ethoxy-3-trichloromethyl-1,2,4-thiadiazole (Etridiazole; Terrazole®)

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The revised EFED environmental risk assessment for 5-ethoxy-3-trichloromethyl-1,2,4-thiadiazole (Etridiazole; Terrazole) reregistration for use on cotton, turf (golf courses), seed treatment, and for ornamental plants is attached. This updated risk assessment included changes to the initial risk assessment (dated 11/10/99) resulting from registrant rebuttle comments and SRRD editorial comments. There are few ecological risks associated with the nonturf uses of Etridiazole; however, at the typical application rate to turf (2 applications at 3.8 lbs a.i./A), acute high risk, restricted use, and endangered species and chronic LOCs are exceeded for terrestrial organisms and acute restricted use and endangered species and chronic LOCs are exceeded for aquatic organisms. Etradiazole is a mobile compound and is expected to persist in stagnant waters where it will likely exert both acute and chronic effects. Additionally, 3-DCMT, a degradate of Etridiazole, is very highly toxic to freshwater fish and, like the parent compound, is mobile and likely to contaminate surface waters. Chronic exposure to Etridiazole resulted in a number of reproductive effects in birds and reduced growth in both fish and aquatic invertebrates. At the maximum application rate to turf, *i. e.*, 5 applications at 3.8 lbs a.i./A for tees and greens, terrestrial and aquatic EECs will be roughly 1.5 times and 1.9 times higher, respectively, and represent a similar increase in the magnitude of exceedences for acute and chronic levels of concern. Furthermore, it is uncertain whether the reproductive effects in birds and growth effects in mammals are indicative of an endocrine-mediated mode of action.

Outstanding Data Requirements

Environmental Fate: The environmental fate database for Etridiazole is mostly complete and adequate for risk assessment.

Ecological Effects: The ecological toxicity data base is incomplete. The registrant should submit the following studies involving the technical grade etradiazole and its degradates:

1. Two-generation reproduction study in rats using technical grade etridiazole (Guideline 83-4).

2. A freshwater invertebrate acute toxicity test using the degradate 3-DCMT (Guideline 72-2).

3. A estuarine/marine fish acute toxicity study using the degradate 3-DCMT (Guideline 72-3a).

4. A estuarine/marine invertebrate acute toxicity study using the degradate 3-DCMT (Guideline 72-3b).

5. A freshwater fish acute toxicity test using the degradate 3-Carb-T (Guideline 72-1).

6. A freshwater invertebrate acute toxicity test using the degradate 3-Carb-T (Guideline 72-2).

Since reproductive effects were demonstrated in both avian and aquatic chronic toxicity studies, EFED recommends that when current testing protocols being considered by the Agency's Endocrine Disruptor Screening Program have been validated, Etridiazole be subjected to more definitive testing to better characterize effects related to its potential endocrine disruptor activity.

Uncertainties

The environmental fate and ecological effects of Etridiazole characterized in this chapter focus primarily on the technical grade active ingredient and on the high application rate proposed for golf courses. Etridiazole's dissipation is dependent on volatilization and to a lesser extent soil metabolism. There is uncertainty as to the role volatilization plays in the dissipation of Terrazole in the environment. Etridiazole may reach surface waters following rain events that produce runoff a few days to weeks after application. Since golf courses are particularly vulnerable to surface water runoff and given the fact that many golf courses are located in coastal areas with sandy soils where Etridiazole is expected to be very mobile, these circumstances combine to make this use site a likely source for surface water contamination.

Chronic mammalian toxicity data were not available for evaluation and represent an uncertainty; when mammalian chronic toxicity data are available from the Health Effects Division, EFED needs to conduct a risk assessment using these data. However, the presence of reproductive effects in birds and fish coupled with the lack of chronic data for mammals constitutes an uncertainty whether Etridiazole exerts an endocrine disrupting effect. Additionally, the toxicity of the degradates (3-DCMT and 3-Carb-T) are poorly characterized pending the submission of additional

data.

Precautionary Label Language

Based on Etridiazole's persistence and the likelihood that the pesticide will contaminate both surface and ground water, the following label language is recommended:

Ground Water Label Advisory

This chemical has properties and characteristics associated with chemicals detected in ground water. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in ground-water contamination.

Surface Water Advisory

Etridiazole can contaminate surface water through spray drift. Under some conditions, Etridiazole may also have a high potential for runoff into surface water for several weeks post-application. These include poorly draining or wet soils with readily visible slopes toward adjacent surface waters, frequently flooded areas, areas over-laying extremely shallow ground water, areas with in-field canals or ditches that drain to surface water, areas not separated from adjacent surface waters with vegetated filter strips.

Based on the anticipated accumulation of Etridiazole in the environment and the calculated risk quotients, Etridiazole exceeds acute endangered species levels of concern for aquatic organisms. The following label language is proposed:

7. This pesticide is toxic to aquatic plants and animals.

8. Drift and runoff may be hazardous to aquatic organisms in water adjacent to treated areas.

9. This product must not be used in areas where impact on threatened or endangered species is likely. Notify state and/or federal authorities and Uniroyal Chemical Company immediately if you observe any adverse environmental effects due to the use of Etridiazole.

10. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwater or rinsate.

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INTRODUCTION

Etridiazole is the common name for the soil fungicide currently or formerly available for agricultural uses under the product names of Terrazole®, Thazol®, Dwell®, Koban® and Truban®. The chemical was introduced in 1969 as a soil fungicide and as a seed treatment. The compound is effective against a narrow range of plant pathogenic soil fungi (the water mold species of the *Fusarium, Pythium, Rhizoctonia,* and *Phytophthora* genera of fungi). The chemical is also an effective inhibitor of soil nitrification and has been applied to delay nitrification of ammonia and urea-based fertilizers by inhibiting the activity of the *Nitrosomons* species of bacteria. This inhibition is reported to provide more nitrogen to crops, reduce the amount of nitrates in the soil surface and in groundwater, and reduce nitrogen loss into the air.

USE CHARACTERIZATION

Etridiazole may be formulated as an emulsifiable concentrate, wettable powder, or granule. It is registered for use on cotton, turf (golf courses), seed treatment, and for ornamental plants (**Table 1**). The major use site for this chemical is on cotton, where it is applied to the seed furrow. The chemical is throughly mixed with the soil that covers the seeds. Etridiazole is applied only once, at planting. The maximum application rate for this use is 0.38 lb. ai/A (the registrant reports a typical use rate of 0.20 lb. ai/A).

Etridiazole may also be used on turf (limited to golf course tees, greens and fairways). The reported (Terrazole Usage Meeting in Preparation for the Issuance of the RED 9/28/98) typical application rate is 1.4 oz ai/1000 sq. ft (3.8 lbs. a.i./A), followed by one application at about 0.7 oz ai/1000 sq. ft (1.9 lbs. a.i./A) (total typical application rate 5.7 lb. ai/A).

Etridiazole is also used on ornamentals, for use in greenhouses, nurseries, and interiorscapes. The reported typical application rate is 6 oz ai/1000 sq. ft (an estimate based on localized uses).

Table 1. Label Rates For Etridiazole

Crop	Max Appl. Rate (lb. ai/A)	Max. # Appl.	Max Yr. Rate (lbs. ai/A)	Min. Interv. (days)	Application methods
cotton	0.38	1	0.38	N/A	ground (in furrow)
turf	3.8	5[1]	19	5	ground (unincorporated)
ornamentals	indoor use	indoor use	indoor use	N/A	ground (at planting)
seed treatment	0.001	1	0.001	N/A	ground (at planting)

1. According to the registrant, the recommended application rate is 5.7 lb ai/A (the initial application at 3.8 lb ai/A, followed by a second application at 1.9 lb ai./A after 5-10 days. For the purpose of the calculation using GENEEC, EFED used two applications at 3.8 lb ai/A at 10 day intervals. The maximum label application rate of 3.8 lb ai/A applied five times (19 lb ai/A/yr maximum) was considered a limited use because it is only applied on tees and greens.

ENVIRONMENTAL FATE ASSESSMENT

Summary

Etridiazole is a mobile compound with moderate persistence; these properties generally would raise concern related to the quality of groundwaters and surface waters in the proximity of affected crops. However, for the low application rates proposed for cotton, ornamental plants, (and seed treatment), EFED believes that the chemical poses a relatively low potential to affect the quality of such bodies of water. Relatively rapid dissipation via volatilization may be expected for the low application rates for these crops. However, turf presents a different scenario because the application rates are very high (50 times higher than for the other crops, at 19 lb a.i./A). This scenario, combined with vulnerable conditions, are likely to result in surface water and possibly groundwater contamination. Once in an aqueous environment, Etridiazole may persist for long periods of time due to its resistance to abiotic degradation (*i.e.*, Etridiazole is stable to hydrolysis and aqueous photolysis).

Table 2 summarizes the physico-chemical properties of Etridiazole. The primary route of dissipation of Etridiazole is volatilization and to a lesser degree aerobic soil metabolism. It is stable to hydrolysis and aqueous photolysis; however, it is somewhat susceptible to soil photolysis. Under aerobic soil metabolism conditions, Etridiazole dissipates slowly following a biphasic pattern consistent with a chemical that readily volatilizes and undergoes slow aerobic degradation. Similar degradation products, *i.e.*, 5-ethoxy-1,2,4-thiadiazole-3-carboxylic acid (3-Carb-T) and 3-dichloromethyl-5-ethoxy-1,2,4-thiadiazole (3-DCMT) were observed in the soil photolysis and the aerobic soil metabolism studies, although the ratios of the degradates in each of the studies were different. Terrestrial field dissipation studies show that Etridiazole has low to moderate persistence ($t_{½}$=4-33 days) and appear to suggest substantial volatilization as evidenced by low recoveries one day after application (although no air sampling was conducted).

Table 2. Physical-chemical properties of Etridiazole.

PARAMETER	VALUE
Chemical name	5-ethoxy-3-trichloromethyl-1,2,4-thiadiazole
Molecular Weight	247.5
Density	1.5 g/mL at 25°C
Solubility	106 ppm in water
Vapor Pressure	1.073×10^{-2} mm Hg at 25°C
pH 5.1 Hydrolysis half life	82 days
pH 7.1 Hydrolysis half life	83 days
pH 8.9 Hydrolysis half life	81 days
Soil Photolysis half life	14.3 days
Aquatic photolysis half life	stable
Aerobic soil dissipation half life	34 days
Octanol-water partition coefficient (K_{ow})	2.3×10^{3}
Henry's Law Constant	3.08×10^{-5}

The moderate rate of dissipation of Etridiazole in the field (ranging from 4 to 33 days) appears to indicate that there is a propensity of contamination of both surface and ground waters if the appropiate environmental conditions are present. The variability in the half-lives is consistent with a compound that volatilizes. Golf courses represent particularly vulnerable use sites prone to contamination of surface waters via run off, additionally, the application rate for gulf courses is the highest of all the use sites (19 lb a.i./A).

Since Etridiazole's dissipation is dependent on both volatilization and to a lesser degree soil metabolism. Etridiazole may reach surface waters following rain events that produce runoff a few days to weeks after application (for two of the terrestrial field dissipation studies, the half-lives were 16 and 33 days). Since Etridiazole is relatively stable to abiotic degradation (hydrolysis, aqueous photolysis), it may persist for considerable periods of time in aquatic areas with long residence times and low microbiological activity. Additionally, based on Henry's Law Constant (3.08×10^{-5} atm•m^3/mol) volatilization from water may or may not be significant depending on environmental conditions (depth of the water, temperature, wind speed and flow rate) (Thomas 1990). The actual rate of volatilization from aqueous environments is relatively slow with a half-life of 25 days (*personal comm.* L. Burns 1999 based on simulated volatilization rate from Georgia pond based on EXAMS run using the steady state mode).

Two degradates (3-Carb-T and 3-DCMT) detected in laboratory studies were monitored in the field. Both degradates had high mobility in laboratory batch equilibrium studies (3-Carb-T K_{ads}= 0.01 - 0.055, and 3-DCMT K_{ads}= 0.13 - 2.8). In the field, the degradate 3-Carb-T was relatively persistent and mobile (relative to the parent compound) while the degradate 3-DCMT appeared to be somewhat persistent, but it did not leach substantially.

Hydrolysis

Etridiazole is stable to hydrolysis. At the three pH's tested (5.1, 7.1 and 8.9) similar calculated half-lives were obtained (81-83 days) (MRID 00001650). The major degradate was 3-Carb-Terr, which increased with time through the 188 days that the study lasted.

Aqueous Photolysis

Etridiazole is presumed to be stable to photolysis in aqueous systems based on the absorption spectrum of the chemical. This study requirement was waived based on the absorption spectrum for the chemical.

Soil Photolysis

Etridiazole degrades in irradiated soil probably via indirect photolysis. The calculated half-life was 14.3 days on sandy loam soil irradiated with a xenon arc lamp for 30 days (MRID 431243-01). One major degradate, 3-Carb-T(maximum 26.35 - 38.03% of the applied at 30 days), and one minor degradate, 3-DCMT (maximum 2.19 - 2.78% of the applied at 14 days), were observed. These

degradates were also observed in the aerobic soil metabolism study, and thus are not exclusive photoproducts.

Aerobic Soil Metabolism

In aerobic soil systems, Etradiazole's calculated half-life was 34 days in sandy loam (75% moisture at **a** barr) incubated for up to 180 days (MRID 435043-01). Dissipation appeared to be biphasic, with an initial half-life of around 14 days, with slower dissipation thereafter. Volatility data indicate that the major route of dissipation in this aerobic soil metabolism study was volatilization (49.9% of the applied volatilized by day 180 in the organic traps was parent Etridiazole). The minor degradates 3-DCMT and 3-Carb-T were reported at less than or equal to 7.0% of the applied.

Anaerobic Aquatic Metabolism

Extraction problems encountered in this study (MRID 435043-05) were not completely resolved with the information provided by the registrant. The available sampling points (60 and 179 days) appear to indicate that at such test intervals, most of the parent is degraded. Although the registrant is not required to conduct an additional anaerobic aquatic metabolism study, EFED reccomends against using the short half life in modeling for risk characterization. It is noteworthy however that a repeat study verifying the shorter half life could significantly reduce EFED's uncertainty regarding the potential persistence of Etridiazole under anaerobic conditions..

Mobility

Etridiazole was moderately mobile in sandy loam, clay, and silt loam, and very mobile in sand:solution slurries (MRID 435043-02). Etridiazole's two identified degradates 3-Carb-T and 3-DCMT were very mobile in four soil:solution slurries. Soil characteristics and results are summarized in **Table 3**.

Table 3. Freundlich K_{ads} and K_{oc} values for Etridiazole and its degradates 3-carboxy-5-ethoxy-1,2,4-thiadiazole (3-Carb-Terr) and 5-ethoxy-3-dichloromethyl-1,2,4-thiadiazole (3-DCM-Terr).

Soil type	% OM	Etridiazole			3-Carb-Terr			3-DCM-Terr		
		K_{ads}	K_{OC}	1/n	K_{ads}	K_{OC}	1/n	K_{ads}	K_{OC}	1/n
sandy loam	4.0	8.2	349	0.86	0.46	20	0.95	2.8	118	0.81
clay	7.17	8.2	195	0.92	0.55	13	0.84	2.1	50	0.89
sand	0.16	0.44	469	0.84	0.01	16	0.99	0.13	148	0.92
silt loam	2.66	5.1	323	1.02	0.34	22	0.75	2.0	128	0.83

The laboratory volatility study confirms what was observed in the aerobic soil metabolism, that Etridiazole is highly volatile. Under worst case scenario (75% RH, 75% field capacity), $\geq$50.43% of the applied were [^{14}C]-volatiles (after 14 days), which were composed mainly of parent Etridiazole. In general, volatility increased with increases in soil moisture and relative humidity. It

appeared that the air flow rate had limited effect in the levels of volatiles. Although the results of the laboratory volatility study trigger a field volatility study, EFED believes no new information would be learned from a field volatility study on Etridiazole.

Bioaccumulation

The octanol/water partition coefficient (2,340) of Etridiazole, indicates that the chemical has a moderate potential to bioaccumulate in fish (MRID 432414-01). Etridiazole residues accumulated with relatively low bioaccumulation factors in bluegill sunfish. The maximum bioconcentration factors were 94X, 328X, and 193X for the edible tissue (muscle, nonedible tissue (viscera and carcass) and whole fish, respectively. Depuration was rapid (observed $DT_{50} \approx 1$ day).

Field Dissipation

The registrant conducted various terrestrial field dissipation studies, using different formulations of Etridiazole in North Carolina, California, and Texas (MRID 446896-03). The product was applied to turf and bare ground plots. The results obtained for bare ground plots are presented in **Table 4** and show that Etridiazole is not very persistent when applied in its different formulations under diverse meteorological conditions at different locations. In general, the dissipation of Etridiazole in turf was erratic; thus, it was not possible to estimate an accurate half-life for Etridiazole on turf. The registrant presented first-order half-lives of parent Etradiazole on grass clippings and thatch in California and North Carolina ranging from 3 to 47 days (r^2 range: 0.866 to 0.988). EFED believes that differences of up to an order of magnitude in the half-lives obtained in two different sites are possible, provided the large number of variables in such environments (*i.e.* temperature, relative humidity, rainfall, sunlight intensity and microbial activity).

Table 4. Terrestrial field dissipation study sites, soil types, formulation tested (WP = wettable product; EC = emulsifiable concentrate; G = granules) and associated half life ($T_{½}$) for Etridiazole.

Location	Soil Type	Formulation	$t_{½}$ (days)
Wilson County, NC	Norfolk sandy loam soil	WP	8
Porterville, CA	Cajon loamy sand	EC	16
Uvalde, TX	Montell clay	G	4
Tulare County, CA	sandy loam	WP	33

It was generally observed that the time zero concentration in the soil, *i.e.*, the concentration immediately after the last treatment, was substantially less than the theoretical concentration. The registrant suggests that volatilization may have occurred.

In the field, generally Etridiazole and its degradate 3-DCMT, did not appear to persist or leach to the subsurface. For example, in the study conducted in Tulare County, 3-DCMT was detected in the 0 to 6-inch soil depth only and through 123 days post-treatment. The degradate 3-

Carb-T was more persistent and leached up to18 to 24 inches in the studies. For example, in the same study, 3-Carb-T had one detection in the 18 to 24-inch soil depth on day 123 post-treatment. Similar patterns were observed in the Porterville and Uvalde studies.

Initially, storage stability data for Etridiazole was not available; EFED has traditionally required that the registrant provide a storage stability study in all the different media tested. The storage stability represents only a small fraction of the cost of a field study and provides important information to EFED. EFED later received storage stability data for Etradiazole and the degradates 3-DCMT and 3-Carb-T in Texas and California indicating the stability of the parent and its degradates under the testing conditions. While no stability data were provided for North Carolina soils EFED believes that new storage stability data will not provide substantial new information.

Spray Drift

Although no Etridiazole-specific studies are required at this time, droplet-size spectrum (Guideline 201-1) and drift field evaluation (Guideline 202-1) studies are required since Etridiazole may be applied as a spray to newly seeded or established turf. The registrant, Uniroyal Chemical Co., is a member of the Spray Drift Task Force (SDTF). The SDTF has completed and submitted to the Agency a series of studies which are intended to characterize spray droplet drift potential due to various factors including application methods, application equipment, meteorological conditions, crop geometry, and droplet characteristics. EFED is currently evaluating these studies. In the interim and for this assessment of Etridiazole, EFED is relying on previously submitted spray drift data and the open literature on off-target drift rates. The rate is 1% of the applied spray volume from ground applications. After its review of the new studies submitted by the SDTF, the Agency will determine whether a reassessment is warranted of the potential risks from the application of Etridiazole to nontarget organisms.

Terrestrial Exposure Assessment

Nongranular Applications

The terrestrial exposure assessment is based on the methods of Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994). Terrestrial estimated environmental concentrations (EECs) for nongranular formulations (**Table 5**) were derived from the maximum application rate for turf, *i.e.*, single (1) and multiple (2) applications of 3.8 lb a.i./ A (10-day interval between applications). Uncertainties in the terrestrial EECs are primarily associated with a lack of data on interception and subsequent dissipation from foliar surfaces. Foliar dissipation rate is based on a number of routes which may include wash off, degradation via photolysis, hydrolysis and volatilization, incorporation into plant tissues. When valid foliar dissipation data are not available, as in this case, EFED estimates calculated dissipation using a default $T_{1/2}$ of 35 days. Predicted residues (EECs) resulting from multiple applications are calculated by adding amount remaining from previous applications to initial concentrations from subsequent applications. For acute exposure the maximum resulting

concentration is used. For chronic assessment both the maximum and the 56-day average concentration are used.

Granular Applications

EECs for incorporated broadcast applications are calculated on the basis of mass (mg) per area (ft^2), corrected for the fraction (15%) of the pesticide left on the surface. For unincorporated broadcast applications, the entire fraction (100%) of the pesticide is assumed to remain on the surface.

Table 5. Estimated environmental concentrations on avian and mammalian food items (ppm) following a single (1), typical (2) applications at 3.8 lbs. a.i./A to turf, and a single (1) application at 0.38 lbs. a.i./A to cotton (Hoerger and Kenaga, 1972, as modified by Fletcher et al, 1994).[1]

App. Rate lbs. a.i./A (# appl./year)	Food Items	EEC (ppm) Predicted Maximum Residue	EEC (ppm) Predicted Mean Residue
Turf 3.8 lbs. a.i./A (1 application/yr)	Short grass	912	557
	Tall grass	418	250
	Broadleaf plants and small insects	513	301
	Fruits, pods, seeds, and large insects	57	33
Turf 3.8 lbs. a.i./A (2 applications/yr)	Short grass	1,660	1,053
	Tall grass	761	481
	Broadleaf plants and small insects	934	588
	Fruits, pods, seeds, and large insects	104	65
Turf (tees and greens) 3.8 lbs. a.i./A (5 applications/yr)	Short grass	3,190	2,036
	Tall grass	1,462	945
	Broadleaf plants and small insects	1,795	1,173
	Fruits, pods, seeds, and large insects	199	132
Cotton 0.38 lbs a.i./A (1 application/yr)	Short grass	91	56
	Tall grass	42	25
	Broadleaf plants and small insects	51	30
	Fruits, pods, seeds, and large insects	6	3

[1]Model assumes a foliar dissipation rate equal to 35 days and a 10-day interval between multip25le applications.

Water Resource Assessment

Ground Water Assessment

Despite the fact that Etridiazole was found to exhibit moderate to high mobility in four soils tested ($K_{ads} \leq 8.2$), EFED believes the chemical may pose only a slight threat to the quality of ground waters because it is volatile and, except for turf, is applied at low application rates. The amount of data for Etridiazole in the Pesticides in Ground Water Database (EPA 734-12-92-001, Sept. 1992)

is very limited. It reported that Etridiazole was sampled only in six wells in CA in 1989. Of six samples, none had detections (detection limit not reported). The majority of the uses of Etridiazole are for seed treatment and the chemical is applied in furrow. The application rates in all such cases are relatively small.

Surface Water Assessment

Etridiazole has potential to contaminate surface water as a result of spray drift during application. It may also runoff if a rain event occurs within days to a few weeks after application (aerobic soil metabolism half-life 34 days, $DT_{50} \approx 14$ days). It appears that during such runoff events, most of the Etridiazole will be dissolved in the water (as opposed to adsorbed to the soil surface). EFED believes Etridiazole is likely to persist in surface waters because it resists abiotic degradation, *i.e.*, it is not susceptible to hydrolysis at any pH and it is not susceptible to photolysis in water. Etridiazole may dissipate faster in waters with high microbiological populations, where aerobic metabolism is favored, and in waters with short hydrologic residence times which favor dissipation. Because Etridiazole has high proposed application rates for use on turf, EFED believes that Etridiazole is likely to reach surface waters during runoff events at such sites. Thus, turf use shows the highest susceptibility and the highest risk.

Drinking Water Assessment

Tier I estimated environmental concentrations (EECs) for Etridiazole are calculated using GENEEC (surface water) and SCIGROW (groundwater) for use in the human health risk assessment. At the request of the Health Effects Division (DP Barcode D260263), Tier II surface water EECs were developed for human health risk concerns and were based on a 36-yr simulation using Mississippi cotton. A copy of the memo is included in **Appendix 3**. For surface water, the acute (peak) value is **228.09 ppb** (Tier I, turf) or **2.277 ppb** (Tier II, cotton), and chronic values are **0.146 ppb** (Tier II cotton, upper 1-in-10-year mean annual concentration) and **0.05 ppb** (Tier II cotton, overall mean). The groundwater screening concentration is **0.926 ppb**.

Aquatic Exposure Assessment

For a Tier 1 assessment, EFED uses GENEEC, a screening model that provides an upper-bound estimate of environmental concentrations (EECs) on a high exposure site. The GENEEC program uses basic environmental fate values and pesticide label information to estimate the EECs in a one-hectare, two-meter deep pond following the treatment of a 10-hectare field. The runoff event occurs two days after the last application. GENEEC takes into account adsorption to the soil or sediment, incorporation of the pesticide, degradation in soil before runoff, and degradation within the water body (**Table 6**). The model also accounts for direct deposition of spray drift onto the water body (assuming 5% of the application rate for aerial spray applications and 1% for ground spray applications). Output from the GENEEC model is in **Appendix 2**.

Table 6. Environmental fate parameters used to predict Etridiazole estimated environmental concentrations (EECs).

Parameter	Etridiazole
water solubility (ppm):	106
K_{oc}	195
aerobic soil metabolism, $t_{1/2}$	34.2 days
hydrolysis $t_{1/2}$, pH 7	83 days
aerobic aquatic metabolism, $t_{1/2}$:	stable
aqueous photolysis $t_{1/2}$:	stable

EECs derived using the preceding input parameters for the Tier I level GENEEC model predict a peak concentration of 228 ppb (**Table 7**). Over a 56-day period, the average concentration was 160 ppb, representing roughly 70% of the predicted peak value. The GENEEC model assumed two applications of 3.8 lbs a.i./A at a 10-day interval and was based on the registrant's recommended application rate of 5.7 lb ai/A (the initial application at 3.8 lb ai/A, followed by a second application at 1.9 lb ai./A after 5-10 days. Although the maximum label application rate of Etridiazole is 3.8 lb ai/A applied five times (19 lb ai/A/yr maximum), EFED considered it a limited use because it is only applied on tees and greens of golf courses. Had EECs been based on the application rates for tees and greens, the peak EEC would have been 437 ppb and the average 56-day EEC would have been 324 ppb.

Table 7. Estimated environmental concentrations (EECs) for aquatic exposure from GENEEC and direct application.

Site	Application Method	Application Rate (lbs ai/A)	# of Apps./ Interval Between Apps.	Initial (PEAK) EEC (ppb)	21-day ave EEC (ppb)	56-day ave EEC (ppb)
GE NEEC						
Cotton	ground incorporated (2", in furrow)	0.38	1 (at planting)	6.13	5.45	4.54
Turf (golf course)	ground (unincorporated)	3.8	2(10 d)[1]	228	203	169
Turf (tees and greens)	ground (unincorporated)	3.8	5(10 d.)	437	389	324
Seed treatment	ground incorporated (1", in furrow)	0.001	1 (at planting)	0.031	0.028	0.023

DeWitt nomogram

1. According to the registrant, the recommended application rate is 5.7 lb ai/A (the initial application at 3.8 lb ai/A, followed by a second application at 1.9 lb ai./A after 5-10 days. For the purpose of the calculation using GENEEC, EFED used two applications at 3.8 lb ai/A at 10 day intervals. The maximum label application rate of 3.8 lb ai/A applied five times (19 lb ai/A/yr maximum) was considered a limited use because it is only applied on tees and greens.

ECOLOGICAL EFFECTS HAZARD ASSESSMENT

Summary

Although Etridiazole is only slightly toxic to terrestrial species in terms of acute toxicity, chronic exposure in birds resulted in reproductive effects including a reduction in numbers of eggs laid, viable embryos, normal hatchlings and 14-day survivors. No chronic toxicity data were available on mammals. Etridiazole is moderately toxic to both freshwater and marine fish and invertebrates. Its degradate, 3-DCMT, is highly toxic to fish. Chronic exposure to Etridiazole resulted in reductions in growth for both freshwater fish and invertebrates. Aquatic plants were the most sensitive species tested with LC_{50} values roughly 100 times lower than the other aquatic organisms tested.

Based on ecological effects data, the toxicity potential of Etridiazole can be characterized as follows:

- Avian acute – practically nontoxic (LC_{50} > 1,650 ppm)
- Avian chronic – reduction in numbers of eggs laid, viable embryos, normal hatchlings and 14-day survivors (NOEC 50 ppm)
- Mammalian acute – slightly toxic (LC_{50} 1,028 ppm)
- Fish (freshwater) acute – moderately toxic (LC_{50} 1.21 - 3.27 mg/L)
- Fish (freshwater) chronic – reduced larval growth (NOEC 0.12 mg/L)
- Fish (marine/estuarine) acute – moderately toxic (LC_{50} 4.0 mg/L)
- Invertebrates (freshwater) acute – moderately toxic (EC_{50} 4.9 mg/L)
- Invertebrates (freshwater) chronic – reduced growth (NOEC 0.37 mg/L)
- Invertebrates (marine/estuarine) acute – moderately toxic (EC_{50} 2.5 mg/L)
- Aquatic plant acute – toxic (EC_{50} 0.072 mg/L)

The toxicity testing does not test all species of birds and fish. Only two surrogate species for birds (bobwhite quail and mallard ducks) and two species of fish (rainbow trout and bluegill sunfish) are used to represent all bird species (> 680) and freshwater fish species (> 2,000) in the United States. For mammals, acute studies are limited to the Norway rat. Estuarine/marine studies include testing a fish (sheepshead minnow), a crustacean (mysid shrimp) and a mollusk (Eastern Oyster); however, reptiles and amphibians are not tested. This assessment assumes that a chemical's mechanism of action and toxicity found for avian species is similar to that in reptiles. The same assumption applies to amphibians and fish; the tadpole stage of amphibians is assumed to have the same sensitivity as a fish. Therefore, the results from toxicity tests (**Appendix 4**) on surrogate species are considered applicable to other member species within their class and are extrapolated to reptiles and amphibians.

Toxicity to Terrestrial Animals

Avian Acute Oral, Subacute Dietary and Chronic

Based on both acute oral (LD_{50} 560 - 1,640 ppm) (Fletcher 1972a; Fletcher 1972c) and subacute dietary (LC_{50} 1,650 to > 5,000 ppm; MRID 624790 and MRID 624780) data, Etridiazole is categorized as slightly toxic to birds. In mallard ducks, food consumption was negatively correlated with the concentration of Etridiazole in the diet. Although Etridiazole should not present an acute toxicity concern to avian species, there is the potential for chronic concerns. Chronic avian reproduction studies were required because birds may be subject to repeated or continuous exposure because of repeated applications. Avian reproduction studies using mallard ducks (MRID 437441-02) and bobwhite quail (MRID 437441-01) resulted in reduced numbers of eggs laid, viable embryos, normal hatchlings and 14-day survivors (NOEC = 50 ppm). The guideline requirements for avian acute oral (Guideline 71-1) and subacute dietary (Guideline 71-2) studies have been fulfilled. The avian chronic toxicity testing requirement (Guideline 71-4) using mallard ducks and bobwhite quail have been fulfilled.

Mammals, Acute and Chronic

Etridiazole is slightly toxic to small mammals on an acute oral basis (LD_{50} > 1,028 ppm; MRID 437245-01); chronic toxicity testing revealed there may be a potential for chronic effects; however, the study was classified as invalid and must be repeated (MRID 000041698).

Toxicity to Freshwater Aquatic Organisms

Freshwater Fish Acute and Chronic

On an acute bases, Etridiazole is moderately toxic to both coldwater rainbow trout (LC_{50} = 1.21 mg/L; MRID 0001703) and the warmwater bluegill sunfish (LC_{50} = 3.27 mg/L; MRID 0001703). Acute toxicity testing using technical end-product (Terrachlor Super X; 12% Etridiazole and 23% pentachlorobenzene) on the same species yielded roughly similar estimates of moderate toxicity to coldwater fish (LC_{50} 2.52 mg/L; MRID 445236-05) and warmwater fish (LC_{50} 9.0 mg/L). Additional data were provided on the acute toxicity of the Etridiazole degradate 5-ethoxy-3-dichloromethyl-1, 2,4,-thiadiazole (3-DCMT; MRID 446067-02); the degradate is highly toxic (LC_{50} = 0.77 mg/L) to freshwater fish.

Because of Etridiazole's acute toxicity (LC_{50} = 1 mg/L), persistence in water, and repeated application, an early life stage toxicity testing is required. A rainbow trout early life-stage test produced an NOEC of 0.12 mg/L (MRID 428346-04) with the most sensitive endpoint being reductions in larval weight. The study is classified as supplemental but can be upgraded to core if the registrant can demonstrate that neither pH nor water hardness affect the toxicity or solubility of Etridiazole. No additional study is required.

Freshwater Invertebrates Acute and Chronic

Etridiazole is moderately toxic to aquatic invertebrates (EC_{50} = 4.9 mg/L; MRID 00062427). The guideline requirement for acute freshwater invertebrate toxicity testing (72-4) is fulfilled.

A daphnid life cycle test produced an MATC of 0.45 mg/L (NOEC = 0.37 mg/L) (Putt 1993) with the most sensitive endpoint being reductions in growth. The study (MRID 428346-05) is classified as core and fulfills chronic freshwater invertebrate toxicity testing (Guideline 72-4) requirements.

Toxicity to Estuarine/Marine Animals

Estuarine/Marine Fish Acute

Etridiazole has moderate toxicity to sheepshead minnow (LC_{50} 4.0 mg/L) (Machado 1993c). The guideline requirement for acute estuarine/marine fish studies (Guideline 72-3) is fulfilled.

Estuarine/Marine Invertebrate Acute

Etridiazole is moderately toxic both to mysid shrimp (EC_{50} 2.5 mg/L) (Machado 1993a) and Eastern oysters (EC_{50} 2.6 mg/L) (Dionne 1993). The guideline requirement for an acute estuarine/marine invertebrate study (Guideline 72-3) is fulfilled.

Toxicity to Aquatic Plants

Etridiazole was most toxic to nonvascular plants, *i.e.*, green algae (LC_{50} 0.072 mg/L) (Hoberg 1993b); vascular plants, *i.e.*, duck weed were several orders-of-magnitude less sensitive to Etriziazole (LC_{50} 8.1 mg/L) (Hoberg 1993e). The guideline requirement for aquatic plant studies (Guideline 122-2) is fulfilled.

ENVIRONMENTAL RISK ASSESSMENT

In order to evaluate the potential risk to aquatic and terrestrial organisms from the use of Etridiazole, risk quotients (RQs) are calculated from the ratio of estimated environmental concentrations (EECs) to ecotoxicity values (**Appendix 5**). For this assessment, EECs were based on the typical application rate for Etridiazole of 3.8 lb ai/A applied 2 times per year. These RQs are then compared to the criteria for the "levels of concern" (LOC's) used by OPP in determinating potential risk to nontarget organisms and the subsequent need for possible regulatory action.

Exposure and Risk to Nontarget Terrestrial Organisms

Etridiazole is slightly toxic to mammals and birds; however, at the proposed application rate for turf, *i.e.*, 3.8 lbs a.i./A, acute high risk, restricted use, and endangered species LOCs and chronic LOCs are exceeded for terrestrial organisms (**Appendix 5**).

Avian acute high risk, restricted use and endangered species LOCs are exceeded following both single (RQ = 0.6) and multiple (2) applications (RQ range: 0.1 - 1) of nongranular products at 3.8 lbs a.i./A on turf . The avian chronic LOC is exceeded for short grass (RQ = 1.1) following a single application of 0.38 mg a.i./A. Single applications to turf at 3.8 lbs a.i./A resulted in exceedances of chronic LOCs for birds (RQ range: 0.7 - 11). Multiple applications (2) to turf at 3.8 lbs a.i./A resulted in exceedances of chronic LOCs for birds (RQ range 1 - 21). At the maximum application rate used on tees and greens, *i.e.*, 5 applications of 3.8 lbs a.i./A acute high risk, restricted use, and endangered species LOCs (RQ range 0.9 - 1.9) and chronic LOCs (RQ range: 3 - 41) are exceeded at the maximum application rate for tees/greens.

For single applications of nongranular products at 3.8 lbs. a.i./A, acute high risk LOCs are exceeded for small (15 g) and intermediate-sized (35 g) mammals feeding on short grasses (RQ range: 0.59 - 0.84). Acute restricted use LOCs are exceeded for both small and intermediate-sized mammals feeding on tall grasses and broadleaf plants/insects (RQ range: 0.27 - 0.47). Acute endangered species LOCs are exceeded for large (1,000 g) mammals feeding on short grass. For multiple applications (2) of nongranular products at 3.8 lbs ai/A, acute high risk, restricted use and endangered species LOCs are exceeded for small (15 g) and intermediate-sized (35 g) mammals feeding on short grass and for small-sized mammals feeding on tall grass and broadleaf plants/insects (RQ range: 0.7 - 1.5). Restricted use and endangered species LOCs are exceeded for large-sized mammals feeding on short grass and intermediate-sized animals feeding on tall grass (RQ range: 0.21 - 0.5). The acute endangered species LOC is exceeded for large mammals feeding on tall grasses and broadleaf plants/insects. At the maximum application rate for tees and greens of golf courses, acute high risk, restricted use, and endangered species LOCs are exceeded for small and intermediate-sized mammals feeding on all food sources except seeds (RQ range 0.9 - 3). Although not evaluated in tabular format, at the application rates proposed for cotton, *i.e.*, 0.38 lbs a.i./A, there are no acute LOCs exceeded for mammals.

Exposure and Risk to Nontarget Freshwater and Marine Aquatic Organisms

Etridiazole is moderately toxic to freshwater and estuarine/marine fish and invertebrates. At the typical application rate for turf, acute restricted use and endangered species LOCs (RQ = 0.19) along with chronic LOCs (RQ = 1.33) were exceeded for freshwater fish (**Appendix 4**). Endangered species LOCs were exceeded for freshwater invertebrates, marine/estuarine fish, and invertebrates (RQ range: 0.05 - 0.09). At the maximum application rate for tees and greens acute restricted use and endangered species LOCs (RQ = 0.36) and chronic LOCs (RQ = 2.70) were exeeceeded for freshwater fish; acute restricted use and endangered species LOCs (RQ range 0.11 - 0.18) were exceeded for marine fish and invertebrates.

For granular products (broadcast applications), acute high risk, restricted use and endangered species LOCs are exceeded for small and intermediate-sized mammals (RQ range 1.1 - 2.6). There are no exceedances for granular products following banded or in-furrow applications.

Exposure and Risk to Plants

Etridiazole is toxic to aquatic plants and acute high risk LOCs were exceeded (RQ = 114) at the typical application rate to turf, *i.e.*, 3.8 lbs/A (**Appendix 5**). Acute endangered species LOCs were exceeded at both the maximum proposed application rate and at rates as low as 0.38 lbs/A.

Endangered Species

At the maximum proposed application rate for Etridiazole on turf, endangered species LOCs are exceeded for terrestrial and aquatic animal species. The Agency has developed the Endangered Species Protection Program to identify pesticides whose use may cause adverse impacts on endangered and threatened species, and to implement mitigation measures that will eliminate the adverse impacts. At present, the program is being implemented on an interim basis as described in a Federal Register notice (54 FR 27984-28008, July 3, 1989), and is providing information to pesticide users to help them protect these species on a voluntary basis. As currently planned, the final program will call for label modifications referring to required limitations on pesticide uses, typically as depicted in county-specific bulletins or by other site-specific mechanisms as specified by state partners. A final program, which may be altered from the interim program, will be described in a future Federal Register notice. The Agency is not imposing label modifications at this time through the RED. Rather, any requirements for product use modifications will occur in the future under the Endangered Species Protection Program.

RISK CHARACTERIZATION

Etridiazole is a soil fumigant that dissipates primarily through volatilization, however, the compound is moderately persistent and mobile and is expected to result in both acute and chronic risk to terrestrial and aquatic organisms. At the typical application rate to turf, *i.e.*, 2 applications at 3.8 lbs a.i./A, Etridiazole is likely to result in both high acute risk and chronic risk to terrestrial organisms. Acute restricted use and endangered species concerns and concerns for chronic toxicity are triggered for aquatic organisms. Chronic exposure to Etridiazole resulted in reproductive effects in birds and growth effects in fish. Although EFED considered the higher (5) application rates used of Etridiazole on tees and greens of golf courses to be a limited, the risks to nontarget organisms roughly doubled compared to the typical application rate to turf. Etridiazole is particularly toxic to aquatic plants; even at the lower application rate (0.38 lbs a.i./A) for cotton, Etridiazole use represents a risk to endangered plant species. Additionally, the Etradiazole degradate, 3-DCMT, is mobile and moderately persistent and is expected to move into aquatic systems where it is very highly toxic to freshwater fish. Additionally, Etridiazole's reproductive effects in birds and diminished growth effects in fish coupled with the lack of chronic toxicity data on mammals constitutes an uncertainty whether this compound exerts an endocrine disrupting effect.

In vulnerable areas such as coastal golf courses, it is likely that Etridiazole will reach surface waters as a result of spray drift or following runoff-producing rain events. Because of its resistance to abiotic degradation in aquatic environments, Etridiazole is expected to persist once it accesses this environment. Although Henry's Constant (3.08×10^{-5} atm•m^3/mole) for Etridiazole indicates that volatilization of the compound may play a role in its dissipation from water, its rate of dissipation would be strongly influenced by environmental conditions. In slow moving or stagnant waters, volatilization of Etridiazole may be a relatively slow process. Thus, when able to move to aquatic environments, Etridiazole is likely to persist, particularly in deep stagnant waters. Given the high potential mobility of both Etridiazole and its degradate 3-DCMT, both compounds are likely to move to surface/ground water particularly where sandy soils and shallow water tables are combined features. The high application rates for turf, *i.e.*, 3.8 lbs a.i./ A, coupled with the fact that golf courses are vulnerable areas to runoff to surface water, renders this use a likely site for surface water contamination.

Nontarget Terrestrial Organisms

Although Etridiazole is only slightly to practically nontoxic to birds, there are both acute and chronic risks to birds at the proposed application rate for turf. After single or multiple broadcast applications of non-granular product at 3.8 lbs ai/A, Etridiazole is likely to result in acute high risk and chronic risk to birds. At the lower application rates proposed for cotton, ornamentals and seed treatment, there are no acute avian ecological concerns based on RQs; however, at the lower rate Etridiazole still represents a risk of chronic toxicity for songbirds.

Chronic exposure to Etridiazole resulted in reproductive effects in birds including reductions in the numbers of eggs laid, viable embryos, normal hatchlings and 14-day survivors. These effects were noted in both bobwhite quail and mallard ducks and represent a serious concern because of Etridiazole's likely access to and persistence in aquatic habitats given its high proposed application rate and vulnerability to runoff that golf courses afford.

Etridiazole is slightly toxic to mammals on an acute basis; however, at the maximum proposed application rate, Etridiazole is likely to represent an acute high risk to mammals. At the lower application rate of 0.38 lbs a.i./A, none of the acute LOCs is exceeded. No valid data were available to assess the chronic toxicity of Etridiazole.

Non-target Aquatic Organisms

Etridiazole is moderately toxic to freshwater and marine organisms; however, its degradate, 3-DCMT, is highly toxic to freshwater fish. Etridiazole is likely to represent an risk of acute toxicity to both freshwater and estuarine/marine endangered species. At the typical application rate for turf, acute restricted use concerns are triggered for freshwater fish. Chronic toxicity for freshwater fish, as evidenced by diminished growth of larvae, is also likely following the typical application rate for Etridiazole to turf.

Of the species tested, aquatic plants (green algae) were the most sensitive to Etridiazole with EC_{50} values (EC_{50} = 0.072 mg/L) roughly 10 times lower than any other aquatic organism tested. Etridiazole use on cotton and turf is expected to result in high risk to aquatic plants following acute exposure.

Endocrine Disruptors

EPA is required under the FFDCA, as amended by FQPA, to develop a screening program to determine whether certain substances (including all pesticide active and other ingredients) "may have an effect in humans that is similar to an effect produced by a naturally-occurring estrogen, or other such endocrine effects as the Administrator may designate." Following the recommendations of its Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC), EPA determined that there was scientific basis for including, as part of the program, the androgen- and thyroid hormone systems, in addition to the estrogen hormone system. EPA also adopted EDSTAC's recommendation that the Program include evaluations of potential effects in wildlife. For pesticide chemicals, EPA will use FIFRA and, to the extent that effects in wildlife may help determine whether a substance may have an effect in humans, FFDCA authority to require the wildlife evaluations. As the science develops and resources allow, screening of additional hormone systems may be added to the Endocrine Disruptor Screening Program (EDSP).

When the appropriate screening and or testing protocols being considered under the Agency's Endocrine Disruptor Screening Program have been developed, Etridiazole may be subjected to additional screening and or testing to better characterize effects related to endocrine disruption.

In chronic toxicity studies of terrestrial and aquatic animals, Etridiazole exposure resulted in a number of reproductive effects and it is uncertain whether these treatment effects are indicative of an endocrine disrupting mode of action. Avian reproduction studies using both bobwhite quail and mallard ducks resulted in reduced numbers of eggs laid, viable embryos, normal hatchlings and 14-day old survivors. Early life stage studies on rainbow trout resulted in reduced larval weight. The presence of reproductive effects in birds and fish coupled with the lack of chronic data on mammals constitutes an uncertainty whether Etridiazole exerts an endocrine disrupting effect. Thus, EFED recommends that when current testing protocols being considered by the Agency's Endocrine Disruptor Screening Program have been validated, Terrazole be subjected to more definitive testing to better characterize effects related to its endocrine disruptor activity.

The environmental fate and ecological effects of Etridiazole characterized in this chapter focus primarily on the technical grade active ingredient and on the high application rate proposed for golf courses. Etridiazole's dissipation is dependent on volatilization and to a lesser extent soil metabolism. There is uncertainty as to the role volatilization plays in the dissipation of Terrazole in the environment. Etridiazole may reach surface waters following rain events that produce runoff a few days to weeks after application. Since golf courses are particularly vulnerable to surface water runoff and given the fact that many golf courses are located in coastal areas with sandy soils where

Etridiazole is expected to be very mobile, these circumstances combine to make this use site a likely source for surface water contamination.

Chronic mammalian toxicity data were not available for evaluation and represent an uncertainty; when mammalian chronic toxicity data are available from the Health Effects Division, EFED needs to conduct a risk assessment using these data. However, the presence of reproductive effects in birds and fish coupled with the lack of chronic data for mammals constitutes an uncertainty whether Etridiazole exerts an endocrine disrupting effect. Additionally, the toxicity of the degradates (3-DCMT and 3-Carb-T) are poorly characterized pending the submission of additional data.

DATA GAPS

The ecological toxicity database for Etridiazole technical is largely complete and adequate for acute risk assessment; however, there are no data available on the chronic mammalian (2-generation rat study) toxicity of technical grade Etridiazole. The chronic mammalian study was classified as invalid by the Health Effects Division and must be repeated.

Since reproductive effects were demonstrated in both avian and aquatic chronic toxicity studies, EFED recommends that when current testing protocols being considered by the Agency's Endocrine Disruptor Screening Program have been validated, Etridiazole be subjected to more definitive testing to better characterize effects related to its potential endocrine disruptor activity.

Of major concern is the toxicity of the Etridiazole degradate 3-DCMT. This compound was demonstrated to be highly toxic to freshwater fish. Acute toxicity data on freshwater invertebrates (Guideline 72-2), marine/estuarine fish (Guideline 72-3a), and marine/estuarine invertebrates (Guideline 72-3b) must be provided to better characterize the toxicity of this degradate.

EFED has no information about the toxicity of the degradate 3-Carb-T, which leached and persisted substantially in the field. Acute toxicity data on freshwater fish (Guideline 72-1) and freshwater invertebrates (Guideline 72-2) must be provided to better characterize the toxicity of this degradate.

APPENDIX 1 SUMMARY OF SUBMITTED ENVIRONMENTAL FATE STUDIES

161-1 Hydrolysis (MRID# 00001650 and others)

[^{14}C]-Etridiazole, at 43.2-46.0 ppm, hydrolyzed slowly in buffered solutions at pH's 5.1, 7.1, and 8.9. The rate of hydrolysis appears to be independent of pH. The calculated half-lives were 82, 83, and 81 days for solutions buffered at pH's of 5.1, 7.1, and 8.9, respectively. It appears that the major degradation products is:

> 3-carboxy-5-ethoxy-1,2,4-thiadiazole (3-Carb-Terr), which increased with time to a maximum of 65.4-72.0% of the applied by day 188 post-treatment (last test interval).
>
> Oxalic acid appears to be a minor degradation product.

161-2 Aqueous Photolysis

Waived, based on the absorption spectrum for the chemical.

161-3 Photolysis on Soil (MRID#43124301)

[^{14}C]-Etradiazole (thiadiazole ring-labeled, chemical name 5-ethoxy-3-trichloromethyl-1,2,4-thiadiazole), at 10 μg/g (dry weight basis), photo-degraded moderately, with a registrant-calculated half-life of 14.3 days on sandy loam soil that was irradiated for 12 hours/day for a period of 30 days using a xenon arc lamp that had an emission spectrum and intensity (330-800 nm) similar to natural sunlight; during this period, the temperature in the chamber was 19-24°C. In contrast, [^{14}C]-etradiazole did not degrade substantially on the same soil kept in the dark. It is noted that the results of the dark control, performed in the same soil than the aerobic soil metabolism, show a marked difference with the aerobic soil metabolism study that the registrant did not address. According to the registrant, in the irradiated soil [^{14}C]-etradiazole decreased from 80.77-89.27% of the applied immediately post-treatment to 49.66-53.52% at 7 days, and 14.50-23.54% at 30 days. In the dark control, [^{14}C]-etradiazole was 80.77-89.27% of the applied immediately post-treatment, and 88.44-89.88% at 30 days. The major degradates observed in the irradiated samples and to a lesser level in the dark control were:

> 5-ethoxy-1,2,4-thiadiazole-3-carboxylic acid (commonly known as 3-carboxylic acid-Etridiazole or 3-Carb-T), which increased to a maximum at 30 days with 26.35-38.03% of the applied. In the dark control, this degradate increased to 6.44-6.68% of the applied at 30 days post-treatment..
>
> 5-ethoxy-3-dichloromethyl-1,2,4-thiadiazole (commonly referred as 3-dichloromethyl-Etridiazole or 3-DCMT), which was a maximum at 14 days, with 2.19-2.78% of the applied and declined to 0.36-1.22 by 30 days post-treatment. In the dark control, this degradate was 0.48% in one replicate on day 14 after treatment.

Two degradates were observed only in the irradiated soils only at ≤0.67% of the applied throughout the study.

5-hydroxy-3-trichloromethyl-1,2,4-thiadiazole (5-hydroxy-Etridiazole or 5-OH-Terr), and

5-ethoxy-3-monochloromethyl-1,2,4-thiadiazole (3-monochloromethyl-Etridiazole or 3-MCL-Terr).

An unidentified compound, "Unknown A," ranged from 2.32 to 5.87% of the applied at 7 through 30 days.

Uncharacterized [^{14}C]-residues totaled a maximum of 6.00-9.11% at 3 days. Volatiles totaled 1.37% of the applied by 30 days, and unextracted [^{14}C]-residues were a maximum of 39.00-40.76% at 30 days. At 30 days, the fulvic acid, humic acid and humin fractions were 3.55, 1.00, and 1.12%, respectively.

162-1 Aerobic Soil Metabolism (MRID# 43504301)

[Thiadiazole ring labeled 3-^{14}C]-Etridiazole, also commonly known as etridiazole, at a nominal rate of 5.0 ppm, dissipated with an overall registrant-calculated half-life of 34 days (r^2=0.98) in aerobic sandy loam soil adjusted to 75% of the moisture at 0.33 bar and incubated in the darkness at 25 ±1 °C for up to 180 days. The dissipation from the soil appeared to be biphasic, with an initial half-life of around 14 days (through 14 days post-treatment) and slower dissipation thereafter. In the soil Etridiazole was 96.2% of the applied immediately post-treatment, 45.3% by day 14 and 1.9% at 180 days post-treatment.

The major route of dissipation of Etridiazole from the soil appeared to be volatilization. In the organic volatiles traps Etridiazole was 10.1% of the applied by day 1, 30.1% by day 14, and 49.9% of the applied at the end of the experiment at 180 days post-treatment.

Two minor degradates were identified:

3-dichloromethyl-5-ethoxy-1,2,4-thiadiazole (3-DCM-Terr), was a maximum of 7.0% at 21 days in the soil. In the organic volatiles, it was 0.32% at day 3 post-treatment and it increased to 6.1% of the applied at 180 days.

5-ethoxy-1,2,4-thiadiazole-3-carboxylic acid (3-Carb. T), was a maximum of 6.7% of the applied by 90 days post-treatment. It was not observed in the volatile traps.

$^{14}CO_2$ accounted for 0.29% of the applied at 1 day post-treatment and increased to 8.2% by 90 days and 21.5-22.2% at 120-180 days post-treatment. Nonextractable [^{14}C] residues were a maximum of 6.0% of the applied at 90 days. No further characterization of the nonextractables was performed.

An important discrepancy between the results of the aerobic soil metabolism study and the dark control in the soil photolysis study was observed. Both studies were conducted using the same soil and, in general, both experiments were similar. The importance of maintaining similar testing conditions between the treated sample and the dark control soil was established as early as 1985 (Whetzel and Creeger, "Standard Evaluation Procedure, Soil Photolysis Studies). However, the registrant indicated that at the time of the study, test guidelines did not require a dark control. This study was completed in 1994, but the raw data indicates that analysis started around January 1993. The "Rejection Rate Analysis" document was published later (September 1993) and clearly states that reliable testing protocols require the use of dark controls.

The reason for the differences in the results of the dark control of the soil photolysis study and the aerobic soil metabolism study are attributed to different conditions between samples, which may have caused the major degradation routes in both studies to differ. EFED notes that if the dark control sample is maintained at substantially different condition, compared to the exposed sample, the significance of the dark control is lost and the part of the analysis related to the dark control would be completely invalid.

At this time, EFED will not require a new study. It appears that a new study would provide relatively little additional information. Therefore, the problems related to this study are considered resolved and no additional data are required.

162-3 Anaerobic Aquatic Metabolism (MRID# 43504305)

This study is classified as invalid because of the following deficiencies:

1. The nonextractable [^{14}C] residues were unreasonably high ($\geq$40.8% of the applied from 7 to 179 days post-treatment). High levels of unextractable radioactivity were observed from 0.5 day after treatment (18.9% of the applied) and increased to 34.1% by 7 days posttreatment). The registrant should have attempted to recover a greater proportion of the [^{14}C] residues for characterization. Furthermore, it is not known if the only extraction with acetonitrile:1% NH_4OH was able to extract 100% of the available parent compound. As a result, the calculation of the half-life of parent Etridiazole may be incorrect. The registrant has argued that the parent Etridiazole had been effectively extracted because initial samples had greater than 98% parent and that at two sampling intervals, *i.e.*, 60 and 179 days, the registrant conducted more extensive extractions. In general however, initial (time zero) samples and subsequent samples are not expected to behave equally, since an adsorption equilibrium may be established. Etradiazole, with a registrant-calculated half-life of less than 1 day would be expected to be essentially degraded by 60 days after treatment (this is the first time point when exhaustive extractions were performed). The non-extractable matter fluctuated from 40 to 58% of the applied starting on day 7.

2. The registrant was told that various measurements of the test system were not provided. The registrant subsequently provided information about the soils and solutions (pH ranged from 4.76-7.49; redox potential ranged from 14-109 mV; and O_2 ranged from 0-0.7 ppm.).

3. Nonradiolabeled plus [3-^{14}C]etradiazole, at 5 ppm, appears to dissipate rapidly, with a registrant-calculated half-life of 0.69 days in anaerobic flooded sandy loam sediment that was incubated in the darkness for up to 179 days.

4. The major degradate was 3-dichloromethyl-Etridiazole (3-DCMT), at a maximum of 29.3% at 2 days posttreatment and decreased to $\leq$0.10% by day 60 posttreatment. Other minor degradates were observed at $\leq$2.7% of the applied radioactivity.

EFED believes that the extraction problem was not completely resolved with the information provided by the registrant. The available points (60 and 179 days) appear to indicate that at such test intervals most of the parent is degraded. Although the registrant is not required to conduct an additional anaerobic aquatic metabolism study, EFED reccomends against using the short half life in modeling for risk assessment/characterization. It is noteworthy however that a repeat study verifying the shorter half life could significantly reduce EFED's uncertainty regarding the potential persistence of Etridiazole under anaerobic conditions..

163-1 Mobility - Batch Equilibrium and Adsorption/Desorption for Etridiazole (MRID# 43504302)

3-[^{14}C]-Etridiazole (also commonly known as etridiazole), at nominal concentrations of 0.2, 0.5, 1.0, 5.0, and 10.0 µg/mL, was determined to be very mobile in sandy loam, clay, sand and silt loam soil:solution slurries (1:5, w:v), that were equilibrated in the dark for 24 hours at 25±1°C. Freundlich K_{ads}, $K_{OC,ads}$, K_{des}, and $K_{OC,des}$ values were as follows:

Soil type	%clay	%OM	pH	K_{ads}	K_{OC}	1/N	K_{des}	K_{OC}	1/N
sandy loam	8.0	4.0	6.6	8.2	349	0.86	10.1	429	0.92
clay	41.2	7.17	7.4	8.2	195	0.92	9.1	215	0.92
sand	3.2	0.16	7.4	0.44	469	0.84	0.60	635	0.95
silt loam	23.2	2.66	7.3	5.1	323	1.02	6.7	429	0.82

163-1 Mobility - Batch Equilibrium and Adsorption/Desorption for Etridiazole-Acid, a Metabolite of Etridiazole (Etridiazole) (MRID# 43504303)

3-[^{14}C]-Etridiazole Acid, at nominal concentrations of 0.2, 0.5, 1.0, 5.0, and 10.0 µg/mL, was determined to be very mobile in sandy loam, clay, sand and silt loam soil:solution slurries (1:5, w:v),

that were equilibrated in the dark for 2 hours at 25±1°C. Freundlich K_{ads}, $K_{OC,ads}$, K_{des}, and $K_{OC,des}$ values were as follows:

Soil type	%clay	%OM	pH	K_{ads}	K_{OC}	1/N	K_{des}	K_{OC}	1/N
sandy loam	8.0	4.0	6.6	0.46	20	0.95	3.8	160	1.1
clay	41.2	7.17	7.4	0.55	13	0.84	2.3	56	0.94
sand	3.2	0.16	7.4	0.01	16	0.99	0.78	861	0.89
silt loam	23.2	2.66	7.3	0.34	22	0.75	3.0	192	1.1

163-1 Mobility - Batch Equilibrium and Adsorption/Desorption for Etridiazole-Dichloro, a Metabolite of Etridiazole (Etridiazole) (MRID# 43504304)

[3-^{14}C]-Etridiazole dichloro, at nominal concentrations of 0.2, 0.5, 1.0, 5.0, and 10.0 µg/mL, was determined to be very mobile in sandy loam, clay, sand and silt loam soil:solution slurries (1:5, w:v), that were equilibrated in the dark for 24 hours at 25±1°C. Freundlich K_{ads}, $K_{OC,ads}$, K_{des}, and $K_{OC,des}$ values were as follows:

Soil type	%clay	%OM	pH	K_{ads}	K_{OC}	1/N	K_{des}	K_{OC}	1/N
sandy loam	8.0	4.0	6.6	2.8	118	0.81	3.4	145	0.74
clay	41.2	7.17	7.4	2.1	50	0.89	1.8	42	0.92
sand	3.2	0.16	7.4	0.13	148	0.92	NA	NA	NA
silt loam	23.2	2.66	7.3	2.0	128	0.83	1.7	109	0.71

NA=Not Available, insufficient adsorption did not permit the calculation of desorption constants.

163-2 Laboratory Volatility (MRID# 43024101)

[^{14}C]-Residues of Etridiazole volatilized at 0.11-0.28 µg/cm^2•hour at 6 hours post-treatment, 0.04-0.16 µg/cm^2•hour at 24 hours, and ≤0.02 µg/cm^2•hour at 120 through 336 hours from sandy loam soil that was treated at 10 µg/g with thiadiazole ring-labeled [3-^{14}C]Etridiazole (5-ethoxy-3-trichloromethyl-1,2,4-thiadiazole; radiochemical purity ≥97%, formulated as a 25% emulsifiable concentrate), adjusted to 25 or 75% of field moisture capacity, and incubated for 14 days (336 hours) at 25 ± 1°C at a relative humidity of 25 or 75% and under an airflow of 31 or 100 cm^3/minute. Volatilized [^{14}C]residues totaled 11.75-61.45% of the applied at 336 hours post-treatment, and were composed primarily of Etridiazole; volatility increased with increases in soil moisture and relative humidity, and appeared to decrease slightly with an increase in air flow rate. The average vapor pressure for the total residues ranged from 4.20×10^{-5} to 36.2×10^{-5} torr at 6 hours post-treatment, and from 0.015×10^{-5} to 0.355×10^{-5} torr at 336 hours.

Air flow		31 cm^3/min				100 cm^3/min			
RH (%)		25		75		25		75	
Field moisture capacity %		25	75	25	75	25	75	25	75
%[^{14}C] volat.	24 Hr	17.47	16.41	16.49	29.82	9.46	15.64	13.96	15.18
	336 Hr	22.56	45.52	27.12	57.40	13.04	37.92	29.88	50.43

The number of actual field volatility studies required by EFED has been traditionally very low. EFED has reconsidered this requirement for Etradiazole; however, since it appears that a field volatility study would not provide substantial new information, no additional data are required on the field volatility of Etradiazole at this time.

164-1 Terrestrial Field Dissipation (MRID# 44689601)

Wilson County, North Carolina; formulation WP

This study is scientifically valid and provides useful supplemental information on the terrestrial field dissipation of Etridiazole (etridiazole), formulated as a wettable powder on a bare ground plot of sandy loam soil in North Carolina.

The part of the study conducted on turf is considered invalid because a high degree of variability did not allow for the determination of an accurate half-life for Etridiazole under such conditions.

Apart from the turf section, this study has been considered supplemental because storage stability data were not reported.

Bare ground

Etridiazole (formulation WP) was broadcast applied three times to bare ground and turf plots as a spray at five day intervals. The nominal application rates were 11.0, 11.0, and 6.0 lb a.i./A, respectively. On the bare ground plot Etridiazole dissipated with a registrant-calculated half-life of 8 days (data from day 1 to 14; $r^2 = 0.85$). A visual inspection of the results, however, indicates that the 50% dissipation time (DT_{50}) occurred approximately between 3 and 7 days.

In the bare ground plot, Etridiazole was present in the 0-6 inch depth at a maximum of 3.4 ppm immediately after the first application. Following the third application, Etridiazole was 0.53 ppm, 0.21 ppm by 7 days, and 0.11 ppm by 89 days post-treatment. Etridiazole was detected briefly in the 6- to 12- inch soil depth from day 1 post-treatment 1 (one replicate) to day 4 post-treatment 1. The chemical was not detected at any other depth in any other test interval.

The degradate 3-(dichloromethyl)-5-ethoxy-1,2,4-thiadiazole (3-DCMT) was observed only in the 0-6 inch soil depth at $\leq$0.069 ppm from day 0 (immediately following the first application) to the day 245 post-treatment 3. The chemical was not detected below the 0- to 6- inch soil depth.

Turf:

In the turf plot, parent Etridiazole was detected through day 178 (at 0.013-1.0ppm). The parent was not detected below the 0-6 inch soil depth.

The degradate 3-DCMT was present in the 0-6-inch depth at 0.010-0.060 ppm immediately after the first application through day 27 after the second application. The degradate 3-DCMT was not detected after day 27 (post-treatment 3) or below the 0- to 6- inch soil level.

The degradate 3-Carb-T was detected sporadically in the 0-6 inch soil depth.

Thatch Samples

In the thatch samples, the parent compound was detected at 2.0 ppm immediately following the first application, it was a maximum of 7.0 ppm at day 1 post-treatment 3. The degradate 3-DCMT was observed to be a maximum of 0.74 ppm on day 45 after the third application. The degradate 3-Carb-T was a maximum by day 1 following the third application, with 0.25 ppm and was last detected at 60 days post-treatment.

Grass

In the grass, Etridiazole was a maximum of 222 ppm immediately following the second application. After the third application, Etridiazole levels decreased rapidly, but at 178 days it was still 1.8 ppm. 3-DCMT reached a low level and was observed through the study period (up to 178 days after the third application, at $\leq$0.051 ppm, 3-Carb-T was a maximum between 0 to 3 days after the third application (maximum 45-178 days post-treatment 3.

164-1 Terrestrial Field Dissipation (MRID# 44689602)

Porterville, California; formulation **EC**

Etridiazole (also commonly known as Etridiazole), broadcast applied once at 10.4 lb ai./A, dissipated with a registrant-calculated half-life of 16 days (0-45 days data; r^2=0.83) on a bare ground plot of Cajon loamy sand soil near Porterville, California.

In the 0-6 inch soil layer, Etridiazole was 0.83 ppm immediately post-treatment, 0.52 ppm by 14 days, and 0.094 ppm by 60 days post-treatment, and 0.094 ppm by 60 days post-treatment. Only one detection was reported below the 0-6 inch soil layer at only 0.018 ppm. A single detection does not constitute a pattern of leaching

The degradate 3-dichloromethyl-5-ethoxy -1,2,4-thiadiazole (commonly known as 3-DCMT), was a maximum of 0.13 ppm by 28 days post-treatment, and was last detected at 270 days with 0.017 ppm. This degradate was not observed below the 0-6 inch soil layer.

The degradate 5-ethoxy-1,2,4-thiadiazole-3-carboxylic acid (commonly known as 3-Carb-T) was a maximum of 0.37 ppm by 28 days post-treatment in the 0-6 inch depth. Several detections were reported in the 6-12, 12-18, and 18-24 inch soil depths (maximum. 0.11 ppm by 60 days in the 6-12 inch soil depth; maximum 0.070 ppm by 90 days in the 12-18 inch soil depth; maximum of 0.029 ppm at 90 days in the 18-24 inch soil depth; the degradate was not detected below the 24 inch soil depth).

Uvalde, Texas; Formulation **G**

Etridiazole (also commonly known as Etridiazole), broadcast applied once at 11..4 lb a.i./A, dissipated from the top 0-6 inch soil depth with a registrant-calculated half-life of 4 days (0-21 days data; r^2=0.95) on a bare ground plot of Montell clay soil near Uvalde., Texas..

In the 0-6 inch soil depth, Etridiazole was 9.4 ppm immediately post-treatment, 4.2 ppm by 3 days, and 0.25 ppm by 21 days. Etridiazole was detected once in the 18-24 inch soil depth at <0.02 ppm (21 days post-treatment).

The degradate 3-DCMT was a maximum of 0.12 ppm 14 days post-treatment in the 0-6 inch soil depth . It was not detected below the 6- inch depth.

The degradate 3-Carb-T was a maximum of 1.9 ppm by day 14-45 post-treatment in the 0-6 inch soil depth. The degradate was last detected at 485 days post-treatment. The degradate was detected in the 6-12 soil depth (maximum 0.087 ppm by 90 days post-treatment), in the 12-18 soil depth (maximum 0.070 ppm by 90 days), in the 18-24 inch soil depth (maximum 0.089 ppm by 90 days post-treatment). Two detections were reported in the 24-30 soil layer (0.012-0.063 ppm) and in the 30-36 inch soil layer (0.011-0.036 ppm).

On 7/99, the EFED received a storage stability study for etradiazole and the degradates 3-DCMT and 3-Carb-T in Texas clay soil for up to 13 months. A screen of the study indicates that it was well conducted and appears to prove stability under the testing conditions.

164-1 Terrestrial Field Dissipation (MRID# 44689603)

Tulare County, California; Formulation **WP**

Etridiazole (also commonly known as Etridiazole), was broadcast applied four times at nominal rates of 10.9 lb a.i./A. and 6.0 lb a.i./A (on the second to the fourth application). The applications were made to bare ground and turf plots of sandy loam soil in Tulare County, California.

Bareground Plot

Etridiazole dissipated from the bare ground with a registrant-calculated half-life of 33 days (data from 0-123 days; r^2=0.97). Based on the nominal application rates, the time zero samples of the bare

ground plot had Etridiazole concentrations significantly below what was expected , based on the application rate.

In the bare ground plot, Etridiazole was 0.23-0.79 ppm from the first application to the fourth application. Etridiazole was 0.32 ppm one day after the fourth treatment and decreased to 0.015-0.032 ppm by 47-123 days after the fourth treatment. A single detection in the 6-12 inch soil depth immediately after the fourth application was 0.019 ppm..

The degradate 3-DCMT was initially detected one day before the second application. It was a maximum of 0.064 ppm by 21 days after the fourth (last) treatment and it was detected through 123 days post-treatment. It was not detected below the 6 inch soil depth.

The degradate 3-Carb-T reached a maximum of 0.078 ppm by day 29 post-treatment (post-application 4). The degradate was observed also in the 6-12 inch soil depth at a maximum of 0.033 ppm at day 61 post-treatment. In the 12-18 inch soil depth two detections were reported at 0.017 ppm on days 91 and 123 post-treatment. Additionally, one detection was reported in the 18-24 inch soil depth at 0.014 ppm at 123 days post-treatment

Turf Plot.

In the turf plot, Etridiazole was a maximum immediately after the third application, with 0.16 ppm and it decreased to 0.019 ppm. After the fourth application, Etridiazole was 0.11 ppm and decreased to 0.029 ppm by 1 day post-treatment. In the 6-12 inch soil depth, Etridiazole was detected twice at only 0.013-0.023 ppm following the second and the third applications.

The degradate 3-DCMT was detected sporadically at low concentrations (0.014-0.020 ppm) from day 0-91 post-treatment and it was not detected below the 6-inch depth.

The degradate 3-Carb-T was a maximum of 0.074 ppm at 21 days post-treatment. It was also observed in the 6-12 inch soil depth at 0.011-0.025 ppm from 21-61 days. 3-Carb-T was not detected below the 6-12 inch soil depth.

Thatch Samples

In the thatch samples, Etridiazole was detected at 3.1-7.8 ppm following the first to the fourth applications. Following the fourth applications, Etridiazole increased from 7.8 ppm (value observed immediately after the fourth application) to 10.3 ppm by day 1 post-treatment. It decreased to 4.4 ppm by 3 days post-treatment and was last detected at 61 days.

The degradate 3-DCMT was observed at a maximum at 0.48 ppm at 3 days after the last application, and decreased to 0.22 ppm by 14 days. The degradate 3-Carb-T was 1.1 ppm at day 0 (immediately after the fourth application), it was 1.8 ppm by 3 days and 0.77 ppm by day 14 post-treatment.

Grass

In the grass samples, Etridiazole was 187 ppm after the first application and it was 1.8 ppm one day prior to the second application. Similar patterns were observed following the second and third applications. Following the fourth application, Etridiazole was 64 ppm and decreased to 53 ppm by 1 day post-treatment and 8.9 ppm after 3 days.

The degradate 3-DCMT was detected at a maximum of 0.40 ppm immediately following the first application. Thereafter, it was detected at low levels ($\leq$0.18 ppm) through day 3 after the last treatment. The degradate 3-Carb-T was 2.0-6.6 ppm immediately after the four applications. The chemical was last detected at 0.20 ppm at 123 days after the last application.

A storage stability study conducted on soils from the California site indicated that parent Etradiazole and its degradates were stable under the storage conditions.

Overview

The registrant monitored the application rate using cellulose application pads in California and North Carolina. In California, the average recovery was 62.5% of the applied (n=12), and in North Carolina the average was 37.4% (n=9). The registrant believes that the low recoveries were caused by the high level of volatilization of etradiazole (Vapor Pressure 1.073×10^{-2} mm Hg @ 25°C). The registrant also believes that, given the number of variables that a field study involves, a field volatilization study would not provide any new information.

Of the four studies, those conducted in Wilson County (NC) and Tulare County (CA) were performed on both turf and bare ground. Turf is the site of major interest because it includes the highest application rate of all the uses of Etridiazole. Unfortunately, on both sites, the data obtained on turf were highly variable and could not be used to estimate a dissipation half-life. Both sites were sandy loams and the dissipation rate varied by less than one order of magnitude (half-life of 8 days in NC, and 33 days in CA). The other two studies, conducted on Porterville (CA) and Uvalde (TX) were performed on bare ground plots and had half-lives of 16 and 4 days, respectively.

165-4 Bioaccumulation in Fish (MRID# 43241401)

[^{14}C]-Etridiazole residues accumulated moderately in juvenile bluegill sunfish that were exposed to thiadiazole ring-labeled [^{14}C]-Etridiazole at a nominal concentration of 0.05 mg/L for 42 days under flow-through conditions. Maximum bioconcentration factors were 94X, 328X, and 193X for the edible tissue (muscle), nonedible tissue (viscera and carcass), and whole fish, respectively.

Depuration was rapid; by day 1 of the depuration period, 64-71% of the accumulated [^{14}C]-residues had been eliminated from the fish tissue.

The degradate 5-hydroxy-3-trichloromethyl-1,2,4-thiadiazole (5-hydroxy-etradiazole) was identified only in the edible tissue. It was 0.09-0.15 mg/Kg in the edible tissue of fish collected after 42 days of exposure to Etridiazole.

The degradate 5-ethoxy–3-dichloromethyl-1,2,4-thiadiazole (3-dichloromethyl etradiazole or 3-DCM-Terr) was identified only in the viscera. It was 4.3-4.9 mg/Kg in the viscera tissue of fish collected after 42 days of exposure to Etridiazole.

The degradate 5-ethoxy-3-carboxy-1,2,4-thiadiazole (3-carboxylic acid etradiazoleor 3-Carb-Terr), which was released during digestion with protease, was identified in both the edible and viscera tissue. It was observed at 0.03 mg/Kg in the edible tissue and 0.55 mg/Kg in the nonedible tissue collected after 42 days of exposure to Etridiazole.

APPENDIX 2 GENEEC OUTPUT FOR TYPICAL AND MAXIMUM APPLICATION RATES FOR TURF

Typical Application Rate (2 applications of 3.8 lbs a.i./A)

RUN No. 3 FOR terrazole INPUT VALUES

RATE (#/AC) ONE(MULT)	APPLICATIONS NO.-INTERVAL	SOIL KOC	SOLUBILITY (PPM)	% SPRAY DRIFT	INCORP DEPTH(IN)
3.800(6.903)	2 10	195.0	106.0	1.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
34.20	0	83.00	.00- .00	.00	83.00

GENERIC EECs (IN PPB)

PEAK GEEC	AVERAGE 4 DAY GEEC	AVERAGE 21 DAY GEEC	AVERAGE 56 DAY GEEC
228.14	224.02	202.86	169.06

Maximum Application Rate for Turf (tees and greens) (5 applications of 3.8 lbs a.i./A)

RUN No. 5 FOR terrazole INPUT VALUES

RATE (#/AC) ONE(MULT)	APPLICATIONS NO.-INTERVAL	SOIL KOC	SOLUBILITY (PPM)	% SPRAY DRIFT	INCORP DEPTH(IN)
3.800(13.195)	5 10	195.0	106.0	1.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
34.20	0	83.00	.00- .00	.00	83.00

GENERIC EECs (IN PPB)

PEAK GEEC	AVERAGE 4 DAY GEEC	AVERAGE 21 DAY GEEC	AVERAGE 56 DAY GEEC
437.32	429.44	388.88	324.09

APPENDIX 3 TIER II SURFACE WATER ASSESSMENT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Prevention, Pesticides, and Toxic Substances
Washington, DC 20460

Nov. 18, 1999

PC Code: 084701
DP Barcode: D260263

MEMORANDUM

SUBJECT: Tier I and Tier II Terrazole EECs for Human Health Risk Assessment.

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TO: Danette Drew
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Health Effects Division (7509C)

Roberta Farrell
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This memo summarizes the Tier I and Tier II Estimated Environmental Concentrations (EECs) for terrazole calculated using GENEEC plus PRZM/EXAMS (surface water) and SCIGROW (ground water) for use in the human health risk assessment. For surface water, the acute (peak) value is **228.09 ppb** (Tier I, turf) or **2.277 ppb** (Tier II, cotton), and chronic values are **0.146 ppb** (Tier II cotton, upper 1-in-10-year mean annual concentration) and **0.05 ppb** (Tier II cotton, overall mean). The groundwater screening concentration is **0.926 ppb** (**Table 1).**

Table 1. Drinking water EECs for Terrazole

	EECs (ppb)	Tier/crop/application rate
Surface Water Peak EEC	**228.09**	Tier I (turf) 3.8 lbs x 2
	2.277	Tier II (cotton) 0.38 lb x 1
Surface water chronic EEC	**0.146**	Tier II (cotton) 0.38 lb x 1 (Top 10 percentile of yearly averages)
	0.050	Tier II (cotton) 0.38 lb x 1 (Mean of 36 yearly averages)
Groundwater EEC	**0.926**	Scigrow (turf) 3.8 lbs x 2

The Tier I surface water acute (GENEEC) value and groundwater (SCIGROW) value represent upper-bound estimates of the concentrations that might be found in surface water and groundwater due to the use of terazzole on turf, which is the worst case scenario for terrazole end use. Tier II surfacewater chronic EECs are predicted based on the 36-years computer simulation of terrazole use in Mississippi cotton field using PRZM/EXAMS. These EEC values are expected to be higher for the turf use, but there is currently no suitable turf scenario for the computer simulation. The list of input parameters, the PRZM input file and all result printouts are also attached.

If you have any questions, please contact us.

Background Information on GENEEC:

GENEEC is a screening model designed to estimate the pesticide concentrations found in water for use in ecological risk assessments. As such, it provides high-end values on the concentrations that might be found in ecologically sensitive environments due to the use of a pesticide. GENEEC is a single-event model (one runoff event), but can account for spray drift from multiple applications. GENEEC is hardwired to represent a 10-ha field immediately adjacent to a 1-ha pond, 2 meters deep with no outlet. The pond receives a spray drift event from each application plus one runoff event. The runoff event moves a maximum of 10% of the applied pesticide into the pond. This amount can be reduced due to degradation on field and the effects of binding to soil. Spray drift is equal to 1% of the applied concentration from the ground spray application and 5% for aerial application.

Though GENEEC was not originally designed for use in drinking water risk assessments, it does provide a reasonable upper-bound estimate for screening purposes. Surface-water-source drinking water tends to come from bodies of water that are substantially larger than a 1-ha pond. Furthermore, GENEEC assumes that essentially the entire basin receives an application of the chemical. In virtually all cases, basins large enough to support a drinking water utility will contain a some fraction of area that does not receive the chemical. Additionally, there is always some flow (in a river) or turnover (in a lake or reservoir) of the water so that the persistence of the chemicals near the drinking water utility intakes will be overestimated. Given all these factors, GENEEC does provide an upper-bound estimate of the concentration of a pesticide that could be found at the drinking water utility and therefore can be appropriately used in screening calculations. If a risk assessment performed using GENEEC output does not exceed the level of concern, then one can be reasonably confident that the actual risk will not be exceeded. However, because GENEEC can substantially overestimate true drinking water concentrations, it will be necessary to refine the GENEEC estimates if the level of concern is exceeded.

Background Information on SCIGROW:

SCIGROW provides a groundwater screening exposure value to be used in determining the potential risk to human health from drinking water contaminated with the pesticide. Since the SCIGROW concentrations are likely to be approached in only a very small percentage of drinking water sources, i.e., highly vulnerable aquifers, it is not appropriate to use SCIGROW concentrations for national or regional exposure estimates.

SCIGROW estimates likely groundwater concentrations if the pesticide is used at the maximum allowable rate in areas where groundwater is exceptionally vulnerable to contamination. In most cases, a large majority of the use area will have groundwater that is less vulnerable to contamination than the areas used to derive the SCIGROW estimate.

Geneec/ Scigrow Inputs and Results:

Table 2 and Table 3 summarize the input values used in the model runs for GENEEC and SCIGROW, respectively. The lowest Koc out of the 4 reported values was used in GENEEC. The median soil Koc value was used in SCIGROW. For the aerobic soil metabolism half-life, the overall half-life in sandy loam was used in GENEEC and SCIGROW modeling. The modeling results associated with maximum allowable rate per year (7.6 lbs ai/acre for turf) are presented in Table 4. Attached to this memo are copies of the original printouts generated from the GENEEC and SCIGROW runs.

Table 2. Environmental Fate Input Parameters for GENEEC.

Chemical	TERRAZOLE
PC Code	084701
Water Solubility (20 ^{0}C)	106 mg/L
Hydrolysis Half Life (pH 7)	83 days
Aerobic Soil Metabolism Half Life	34.2 days
Aerobic Aquatic Metabolism Half Life	To be reviewed
Photolysis Half Life	14.3 days
Organic Carbon Adsorption Coefficient (Koc; lowest value)	195 ml/g

Table 3. Environmental Fate Input Parameters for SCIGROW.

Chemical	Terrazole
Organic Carbon Partition Coefficient (Koc; median value)	323 ml/g
Aerobic Soil Metabolism Half-Life	34.2 days

Table 4. Modeling Results for Use of Terrazole on Turf

Crops	Turf
Application Method	Ground spray
Formulation	Wet. Powder
Application Rate (lbs ai/A)	3.8
Application Frequency	2
Application Interval (days)	10
GENEEC Peak EEC	228.09 ppb
GENEEC 56-Day EEC(ppb)	160.31 ppb
SCIGROW Groundwater Concentration (ppb)	0.926 ppb

GENEEC PRINTOUT

GENEEC RUN FOR TURF ENDUSE (GOLF COURSE)

3.8 lbs x 2 appl. (10 d. interval)
WP soil spray

RUN No. 1 FOR TERRAZOLE INPUT VALUES

RATE (#/AC) ONE(MULT)	APPLICATIONS NO.-INTERVAL	SOIL KOC	SOLUBILITY (PPM)	% SPRAY DRIFT	INCORP DEPTH(IN)
3.800(6.903)	2 10	195.0	106.0	1.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
34.20	0	N/A	14.30- 1754.61	68.40	65.83

GENERIC EECs (IN PPB)

PEAK GEEC	AVERAGE 4 DAY GEEC	AVERAGE 21 DAY GEEC	AVERAGE 56 DAY GEEC
228.09	223.25	198.66	160.31

Seed Treatment (ground incorporated, 1" furrow)

RUN No. 2 FOR Etridiazole INPUT VALUES

RATE (#/AC) ONE(MULT)	APPLICATIONS NO.-INTERVAL	SOIL KOC	SOLUBILITY (PPM)	% SPRAY DRIFT	INCORP DEPTH(IN)
.001(.001)	1 1	195.0	106.0	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
34.00	2	83.00	14.30- 1754.61	.00	79.25

GENERIC EECs (IN PPT)

PEAK GEEC	AVERAGE 4 DAY GEEC	AVERAGE 21 DAY GEEC	AVERAGE 56 DAY GEEC
31.48	30.89	27.88	23.10

SCIGROW RUN FOR TERRAZOLE/TURF ENDUSE INPUT VALUES

APPL (#/AC) RATE	APPL. NO.	URATE (#/AC/YR)	SOIL KOC	SOIL AEROBIC METABOLISM (DAYS)
3.800	2	7.600	323.0	34.2

GROUND-WATER SCREENING CONCENTRATIONS IN PPB

.925656

A= 29.200 B= 328.000 C= 1.465 D= 2.516 RILP= 2.175
F= -.914 G= .122 URATE= 7.600 GWSC= .925656

Background Information on PRZM/EXAMS simulation:

To calculate surface water EECs, an application at the maximum rate onto a ten hectare cotton field draining into a one hectare confined pond, two meters deep with no outlet was simulated. A field located in Yazoo County, Mississippi was used in the simulation. The soil in this area is Loring silt loam (Hydrologic Group C) in MLRA O-134. The weather, agricultural practices, and terrazole applications were simulated over 36 years so that the ten year excedence probability at the site could be estimated. The EEC's generated in this analysis were estimated using PRZM 3.12 (Pesticide Root Zone Model) for simulating runoff and erosion from the agricultural field and EXAMS 2.97.5 (Exposure Analysis Modeling System) for estimating environmental fate and transport in surface water. The list of input parameter (Table 5), the PRZM input file (Table 6) and the result printouts (Table 7) are attached as follows:

Table 5. PRZM/EXAMS model input parameters for terrazole

Chemical	terrazole
Molecular Weight	247.5
Solubility	106 mg L^{-1}
Vapor Pressure	1.0 x 10^{-8} torr
pH 5 Hydrolysis half life	82 d.
pH 7 Hydrolysis half life	83 d.
pH 9 Hydrolysis half life	81 d.
Soil Photolysis half life	14..3 d.
Aquatic photolysis half life	0*
Aerobic soil metabolism half life	102.6 d. (34.2 d. x 3)
Anaerobic soil metabolism half life	0.69 d.
Aerobic aquatic metabolism half life	0*
Anaerobic aquatic metabolism half life	0*
Soil organic carbon partitioning (Koc)	195
Crops	Cotton
# of crop period (# of years simulated)	36 years
Application Rate	0.38 lb
Number of Applications	1
Time of Application	At planting time
Application Method	Ground appl. (2" soil incorporation)

* No data available.

Table 6. PRZM Input File

```
*** PRZM 3.1.2 Input data File, TZOLECOT.INP for TERRAZOLE on COTTON ***
*** Location: Yazoo County, Mississippi; MLRA: O-134 ***
*** Weather: MET134.MET Jackson, MS ***
*** Manning's N: Assume fallow surface with residues not more than 1 ton/acre ***
TERRAZOLE
Location: Jackson Co. MS    Crop: cotton    MLRA 134
    0.76    0.15       0   17.00       1       1
       4
    0.49    0.40    0.75   10.00    5.80       4    6.00   354.0
       3
       1    0.20  125.00   98.00       3  85  78  77                0.00  120.00
       2    0.20  125.00   98.00       3  79  69  68                0.00  120.00
       3    0.20  125.00   98.00       3  84  68  68                0.00  120.00
       1       3
0105 0709 2209
0.63 0.16 0.18
0.17 0.17 0.17
       2       3
0105 0709 2209
0.16 0.13 0.13
0.17 0.17 0.17
       3       3
0105 0709 2209
0.16 0.13 0.09
0.17 0.17 0.17
      36
  01 548  07 948  220948       1
  01 549  07 949  220949       2
  01 550  07 950  220950       3
  01 551  07 951  220951       1
  01 552  07 952  220952       2
  01 553  07 953  220953       3
  01 554  07 954  220954       1
  01 555  07 955  220955       2
  01 556  07 956  220956       3
  01 557  07 957  220957       1
  01 558  07 958  220958       2
  01 559  07 959  220959       3
  01 560  07 960  220960       1
  01 561  07 961  220961       2
  01 562  07 962  220962       3
  01 563  07 963  220963       1
  01 564  07 964  220964       2
  01 565  07 965  220965       3
  01 566  07 966  220966       1
  01 567  07 967  220967       2
  01 568  07 968  220968       3
  01 569  07 969  220969       1
  01 570  07 970  220970       2
  01 571  07 971  220971       3
  01 572  07 972  220972       1
  01 573  07 973  220973       2
  01 574  07 974  220974       3
  01 575  07 975  220975       1
  01 576  07 976  220976       2
  01 577  07 977  220977       3
  01 578  07 978  220978       1
  01 579  07 979  220979       2
  01 580  07 980  220980       3
  01 581  07 981  220981       1
  01 582  07 982  220982       2
  01 583  07 983  220983       3
Application Schedule: 1 appl.; 0.38 lbs/A (0.426kg/H)
*** DIRECT APPLICATION INTO INFURROW AT PLANTING TIME ***
      36       1       0       0
Terrazole  Koc:195   AeSM: T1/2=34.2  days, AnSM: T1/2=
  050448  0 1 5.00 0.426 1.00 0.00
  050449  0 1 5.00 0.426 1.00 0.00
  050450  0 1 5.00 0.426 1.00 0.00
  050451  0 1 5.00 0.426 1.00 0.00
  050452  0 1 5.00 0.426 1.00 0.00
  050453  0 1 5.00 0.426 1.00 0.00
```

```
  050454  0 1 5.00 0.426 1.00 0.00
  050455  0 1 5.00 0.426 1.00 0.00
  050456  0 1 5.00 0.426 1.00 0.00
  050457  0 1 5.00 0.426 1.00 0.00
  050458  0 1 5.00 0.426 1.00 0.00
  050459  0 1 5.00 0.426 1.00 0.00
  050460  0 1 5.00 0.426 1.00 0.00
  050461  0 1 5.00 0.426 1.00 0.00
  050462  0 1 5.00 0.426 1.00 0.00
  050463  0 1 5.00 0.426 1.00 0.00
  050464  0 1 5.00 0.426 1.00 0.00
  050465  0 1 5.00 0.426 1.00 0.00
  050466  0 1 5.00 0.426 1.00 0.00
  050467  0 1 5.00 0.426 1.00 0.00
  050468  0 1 5.00 0.426 1.00 0.00
  050469  0 1 5.00 0.426 1.00 0.00
  050470  0 1 5.00 0.426 1.00 0.00
  050471  0 1 5.00 0.426 1.00 0.00
  050472  0 1 5.00 0.426 1.00 0.00
  050473  0 1 5.00 0.426 1.00 0.00
  050474  0 1 5.00 0.426 1.00 0.00
  050475  0 1 5.00 0.426 1.00 0.00
  050476  0 1 5.00 0.426 1.00 0.00
  050477  0 1 5.00 0.426 1.00 0.00
  050478  0 1 5.00 0.426 1.00 0.00
  050479  0 1 5.00 0.426 1.00 0.00
  050480  0 1 5.00 0.426 1.00 0.00
  050481  0 1 5.00 0.426 1.00 0.00
  050482  0 1 5.00 0.426 1.00 0.00
  050483  0 1 5.00 0.426 1.00 0.00
     0.       1    0.00
Soil Series: Loring silt loam; Hydrogic Group C
  125.00    0.00   0   0   0   0   0   0   0   0   0
    0.00    0.00   00.00
       3
       1   10.00   1.600   0.294   0.000   0.000   0.000
           0.007   0.007   0.000
           0.100   0.294   0.094   1.160   2.262
       2  10.000   1.600   0.294   0.000   0.000   0.000
           0.007   0.007   0.000
           0.500   0.294   0.094   1.160   2.262
       3 105.000   1.800   0.291   0.000   0.000   0.000
           0.007   0.007   0.000
           5.000   0.147   0.087   0.174   0.339
       0
    WATR    YEAR      10    PEST    YEAR      10    CONC    YEAR      10   1
       8 TZOLECOT.CHM
       8 TERRAZOLE
       5    DAY
    RFLX    TSER   0   0   1.E5
    EFLX    TSER   0   0   1.E5
    ESLS    TSER   0   0
    RUNF    TSER   0   0
    PRCP    TSER   0   0
```

Table 7. Results of PRZM/EXAMS simulation

WATER COLUMN DISSOLVED CONCENTRATION (PPB)

YEAR	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
1948	4.256	4.035	2.893	1.511	1.060	.289
1949	.008	.007	.005	.003	.002	.001
1950	.641	.582	.454	.240	.169	.045
1951	.067	.061	.041	.026	.021	.005
1952	2.227	2.018	1.380	.715	.502	.126
1953	.743	.673	.472	.277	.197	.051
1954	.384	.348	.245	.128	.090	.023
1955	.118	.107	.073	.039	.038	.011
1956	.018	.016	.013	.008	.006	.002
1957	.037	.035	.024	.013	.009	.003
1958	.604	.549	.410	.221	.157	.046
1959	.029	.027	.018	.010	.007	.002

1960	.756	.686	.505	.283	.202	.052
1961	.437	.396	.271	.148	.105	.027
1962	.046	.043	.030	.016	.013	.004
1963	.005	.005	.003	.002	.001	.000
1964	3.344	3.031	2.196	1.286	.911	.250
1965	.403	.365	.255	.133	.094	.025
1966	.995	.935	.659	.343	.240	.066
1967	.772	.700	.541	.310	.223	.063
1968	.077	.070	.053	.031	.023	.006
1969	.920	.834	.571	.302	.213	.054
1970	2.230	2.021	1.511	.805	.566	.159
1971	.035	.032	.023	.013	.009	.003
1972	.635	.575	.394	.204	.145	.035
1973	1.441	1.349	1.017	.533	.376	.105
1974	2.386	2.163	1.479	.766	.537	.140
1975	.056	.051	.035	.019	.013	.004
1976	.003	.002	.002	.001	.001	.000
1977	.071	.064	.045	.025	.018	.005
1978	.104	.096	.070	.047	.034	.009
1979	1.340	1.215	.882	.553	.396	.110
1980	.368	.334	.228	.122	.086	.022
1981	.151	.137	.097	.053	.038	.011
1982	.488	.442	.325	.186	.131	.034
1983	.230	.209	.143	.075	.052	.014

SORTED FOR PLOTTING

PROB	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
.027	4.256	4.035	2.893	1.511	1.060	.289
.054	3.344	3.031	2.196	1.286	.911	.250
.081	2.386	2.163	1.511	.805	.566	.159
.108	2.230	2.021	1.479	.766	.537	.140
.135	2.227	2.018	1.380	.715	.502	.126
.162	1.441	1.349	1.017	.553	.396	.110
.189	1.340	1.215	.882	.533	.376	.105
.216	.995	.935	.659	.343	.240	.066
.243	.920	.834	.571	.310	.223	.063
.270	.772	.700	.541	.302	.213	.054
.297	.756	.686	.505	.283	.202	.052
.324	.743	.673	.472	.277	.197	.051
.351	.641	.582	.454	.240	.169	.046
.378	.635	.575	.410	.221	.157	.045
.405	.604	.549	.394	.204	.145	.035
.432	.488	.442	.325	.186	.131	.034
.459	.437	.396	.271	.148	.105	.027
.486	.403	.365	.255	.133	.094	.025
.514	.384	.348	.245	.128	.090	.023
.541	.368	.334	.228	.122	.086	.022
.568	.230	.209	.143	.075	.052	.014
.595	.151	.137	.097	.053	.038	.011
.622	.118	.107	.073	.047	.038	.011
.649	.104	.096	.070	.039	.034	.009
.676	.077	.070	.053	.031	.023	.006
.703	.071	.064	.045	.026	.021	.005
.730	.067	.061	.041	.025	.018	.005
.757	.056	.051	.035	.019	.013	.004
.784	.046	.043	.030	.016	.013	.004
.811	.037	.035	.024	.013	.009	.003
.838	.035	.032	.023	.013	.009	.003
.865	.029	.027	.018	.010	.007	.002
.892	.018	.016	.013	.008	.006	.002
.919	.008	.007	.005	.003	.002	.001
.946	.005	.005	.003	.002	.001	.000
.973	.003	.002	.002	.001	.001	.000
1/10	**2.277**	2.064	1.489	.778	.546	**.146**

MEAN OF ANNUAL VALUES = **.050**

STANDARD DEVIATION OF ANNUAL VALUES = .069

UPPER 90% CONFIDENCE LIMIT ON MEAN =   .067

APPENDIX 4 ECOLOGICAL EFFECTS ASSESSMENT

The available acute toxicity data on the technical grade active ingredient indicate that Etridiazole is slightly toxic to practically nontoxic to birds (LD_{50} = 560 - 1,640 mg/kg; LC_{50} = 1,650 - 5,000 ppm), moderately toxic to freshwater and marine organisms (LC_{50} 1.21 - 4.9 ppm) and very highly to moderately toxic to aquatic plants (EC_{50} = 0.072 - 8.0 ppm). Chronic toxicity studies established the following NOAEC values: 50 ppm for birds, 0.12 ppm for freshwater fish, and 0.37 ppm for freshwater invertebrates. It is important to note that studies conducted prior to the mid- to late 80's and although they were classified as either supplemental or core, they do not meet current guideline standards. Methodologies on many of the studies were poorly documented and in some cases the percent active ingredient was omitted. Older studies should not be viewed as benchmark and are thus not readily compared to the ecotoxicity data base.

Toxicity to Terrestrial Animals

Birds, Acute and Subacute

Etridiazole was classified as slightly toxic to both bobwhite quail and mallard ducks (**Table 1**). The bobwhite quail study was listed as core even though a number of methodological details were missing. The mallard duck study was classified as supplemental since the methodological details were omitted and appropriately formulated controls were not run concurrently with the Etridiazole treated birds. Since the LD_{50} falls in the range 501 to 2000 mg/kg, Etridiazole is categorized as slightly toxic to avian species on an acute oral basis. The guideline 71-1 is fulfilled (MRID 00002238; Fletcher 1972 b).

Table 1. Summary of 14-day avian acute oral toxicity tests in bobwhite quail and mallard duck.

Species	% A. I.	LD50 mg/kg	MRID No. Author/year	Toxicity Category	Classification
Northern Bobwhite	95 - 97%	560 (350 - 890)	00002238 Fletcher 1972	slightly toxic	Core
Mallard Duck	95 - 97%	1,640 (540 - 4,930)	0003276 Fletcher 1972	slightly toxic	Supplemental

Etridiazole technical was classified as practically nontoxic in bobwhite quail (MRID 624780) and slightly toxic in mallard ducks (MRID 624790) (**Table 2**) on a subacute dietary basis. Bobwhite quail treated with 2,500 and 5,000 ppm of Etridiazole exhibited a significant difference ($P < 0.05$) in overall body weight gain during the 8-day test. The quail study was classified as supplemental since a control group was not run concurrently with the Etridiazole-treated groups. While there was no difference in the amount of food consumed between control and treatment groups, there was a significant difference in grams gained per grams of food consumed for the treatment versus control groups. In mallard ducks, signs of toxicity included hyporeactivity and anorexia at the 1,250 ppm, 2,500 ppm and 5,000 ppm treatment levels. Food consumption was negatively correlated with dose at these three highest treatment levels. Both of these studies were classified as supplemental.

Table 2. Summary of 5-day subacute dietary toxicity test in bobwhite quail and mallard duck.

Species	% A. I.	LC_{50} ppm (95% CI)	MRID No. Author/year	Toxicity Category	Classification
Northern Bobwhite Quail *Colinus virginianus*	95%	> 5,000	624780 Fletcher 1973	Practically nontoxic	Supplemental
Mallard Duck *Anas platyrhynchus*	95%	1,650 (1,231 - 2,211)	624790 Bio-Life Assoc. 1981	Slightly toxic	Supplemental

Since the LC_{50} falls in the range of 1001 to 5,000 ppm, Etridiazole is categorized as slightly toxic to avian species on a subacute dietary bases. The guideline (71-2) is not fulfilled.

Testing (Dieterich 1965) of a formulated product of Etridiazole (12% Etridiazole 23% pentachloronitrobenzene) resulted in LC_{50} estimates for bobwhite quail and mallard ducks of > 17,800 ppm and > 21,500 ppm, respectively. Food consumption in mallards was comparable to controls; however quail food consumption was reduced by approximately 25%. Both studies were classified as supplemental.

Birds, Chronic

An avian reproduction study using mallard ducks (Guideline 71-4a; MRID 437441-02) indicated that the NOAEL was 50 ppm based on a reduction in a number of variables: the number of eggs laid, eggs set, viable embryos, normal hatchlings, and 14-day old survivors (**Table 3**). Significant effects were noted in reduced body weight among of hatchlings and 14-day old survivors in ducks treated with greater than 350 ppm. In a pilot study to examine avian reproduction effects in mallard ducks (MRID 437441-03) the NOEAC was 250 ppm and the LOEC was 500 ppm; the

most sensitive endpoint was female body weight. In a similar study using Bobwhite quail (MRID 437441-01), the NOEC was determined to be 50 ppm based upon a reduction in the numbers of normal hatchlings and 14-day-old survivors and a reduction in the percentages of live 3-week embryos of viable embryos, normal hatchlings of live embryos, normal hatchlings of eggs laid, 14-day hatchling survivors of normal hatchlings, normal hatchlings of eggs set, and 14-day hatchlings survivors of eggs set. Both studies are classified as supplemental because exposure levels were changed one week into the study. No additional study is required.

Table 3. Avian reproduction studies of mallard ducks exposed to Etridiazole (ppm).

Species	% A. I.	NOAEL/ LOEC (ppm)	LOEC endpoints	MRID No. Author/year	Classification
Mallard Duck	95%	50 350	reproduction survival	437441-02 Pedersen and Solatycki 1995	Supplemental
Bobwhite Quail	95%	50 350	reproduction survival	437441-01 Pedersen and Solatycki 1995	Supplemental

Mammals, Acute and Chronic

Toxicity testing in mammals indicates that Etridiazole is slightly toxic to small mammals on an acute oral basis LD_{50}=1,028 mg/kg) (**Table 4**). The rat chronic study **was classified as invalid** and must be repeated.

Table 4. Mammalian acute oral and chronic 2-generation toxicity studies of Etridiazole in the Norwegian rat.

Species/ Study Duration	%ai	Test Type	Toxicity Value	Affected Endpoints	MRID No.
laboratory rat (*Rattus norvegicus*)	> 95%	Acute oral	*LD_{50}, 1028 mg/kg*	*Mortality*	*437245-01*

Toxicity to Freshwater Aquatic Animals

Freshwater Fish

The results of the 96-hour acute toxicity studies (**Table 5**) indicate that Etridiazole is moderately toxic to both bluegill sunfish and rainbow trout. Although the bluegill sunfish study (MRID 0001703) and rainbow trout study (MRID 0001703) were classified as core, the percent active ingredient was not specified and was assumed to be technical grade (95 - 97% a.i.) based on data provided on a similar formulation from a secondary study (MRID 00002238).

Table 5. Summary of acute 96-hr flow-through toxicity tests on bluegill sunfish *(Lepomis macrochirus*) and rainbow trout (*Oncorhynchus mykiss*) for Etridiazole (NS = not specified).

Species	% A. I.	LC_{50} ppm	MRID No. Author/year	Toxicity Category	Classification
Bluegill sunfish	95 - 97%	3.27[a] (2.65 - 4.04)	0001703 Sleight 1971	moderately toxic	Core
Bluegill sunfish	12%	9.0	00001572 Dieterich 1965	moderately toxic	Supplemental
Rainbow trout	95 - 97%	1.21[a] (0.97 - 1.50)	0001703 Sleight 1971	moderately toxic	Core
Rainbow trout	12%	2.52	00001572 Dieterich 1965	moderately toxic	Supplemental

[a]LC_{50} value reported for 9 days (216 hours)

Since the LC_{50} for bluegill (LC_{50} = 3.27 mg/L) and rainbow trout (LC_{50} = 1.21 mg/L) fall in the range of 1 to 10 mg/L, Etridiazole is categorized as moderately toxic to freshwater fish on an acute exposure basis. The guideline (72-1) is fulfilled.

Additional studies using formulated product (Terrachlor Super X) resulted in decreased toxicity to bluegill sunfish (96-hr LC_{50} = 9.0 mg/L) and rainbow trout (96-hr LC_{50} = 2.52 mg/L); the study was classified as supplemental even though the percent active ingredient of Etridiazole was not provided. The review did note that the formulation was believed to contain 12% Etridiazole and 23% pentachloronitrobenzene. Based on these data, the formulated product is classified as moderately toxic to fish.

Data were provided on the acute toxicity of the Etridiazole degradate 5-ethoxy-3-dichloromethyl-1, 2, 4,-thiadiazole (3-DCMT) (MRID 446067-02) (**Table 6**). The estimated LC_{50} was 0.77 mg a.i./L. Since the LC_{50} falls in the range of 0.1 to 1.0 mg/L, DCMT is classified as highly toxic to freshwater fish.

Table 6. Summary of acute 96-hr flow-through toxicity tests on rainbow trout (*Oncorhynchus mykiss*) for Etridiazole degradate 5-ethhoxy-3-dichloromethyl-1,2,4-thiadiazole (3-DCMT).

Species	% A. I.	LC_{50} mg/L	MRID No. Author/year	Toxicity Category	Classification
Bluegill sunfish	99.75%	0.77 (0.63 - 0.95)	446067-02 Sousa 1998	highly toxic	Core

Freshwater Fish, Chronic

A freshwater fish early life-stage test using the TGAI is required for Etridiazole because the end-use product may be transported to water from use on coastal sites (golf courses) and the acute toxicity tests with the Etridiazole degradate (3-DCMT) resulted in an LC_{50} less than 1 mg/L. Larval weight (NOEC = 0.12 mg/L) was the most sensitive endpoint (MRID 428346-04). The study is classified as supplemental but can be upgraded to core if the registrant demonstrates that neither pH nor water

hardness affect the toxicity or solubility of Etridiazole (**Table 7**). Although the study is classified as supplemental, it does not have to be repeated.

Table 7. Freshwater fish early life-stage toxicity using rainbow trout in a flow-through conditions for Etridiazole.

Species	% A. I.	NOEC/ LOEC	MATC[1]	LOEC endpoints	MRID No. Author Year	Classification
rainbow trout *Oncorhynchus mykiss*	99%	0.12 mg/L 0.24 mg/L	0.17 mg/L	larval weight	428346-04 Machado 1993	Supplemental

[1] defined as the geometric mean of the NOAEC and the LOEC; thus MATC equals antilog of ((ln NOAEC + ln LOEC) ÷ 2)

Freshwater Invertebrates, Acute

Results of aquatic invertebrate toxicity testing using TGAI are tabulated below (**Table 8**). Since the EC_{50} falls in the range of 1 to 10 mg/L, Etridiazole is classified as moderately toxic to aquatic invertebrates on an acute basis.

Table 8. Summary of acute 48-hr flow through toxicity test on water fleas (*Daphnia magna*) for Etridiazole.

Species	% A. I.	EC_{50} mg/L	MRID No. year	Toxicity Category	Classification
Water Flea	95%	4.9 (3.7 - 6.5)	62427 1979	moderately toxic	Supplemental

Freshwater Invertebrate, Chronic

A freshwater aquatic invertebrate life-cycle test using the TGAI is required for Etridiazole since the end-use product may be transported to water from use on coastal sites (golf courses), the acute toxicity tests with the Etridiazole degradate (3-DCMT) resulted in an LC_{50} less than 1 mg/L, and the pesticide is potentially persistent in water, *i.e.*, half life 81 - 83 days. Results (**Table 9**) from the study indicate that growth (dry weight) was the most sensitive endpoint (NOEC = 0.37 mg/L). This study (MRID 428346-05) is classified as core and fulfills guideline (Guideline 72-4) requirements.

Table 9. Summary of freshwater aquatic invertebrate early life cycle test on water fleas (*Daphnia magna*) for Etridiazole.

Species	% A. I.	NOEC/ LOEL	MATC[1]	MRID No. Author/year	Endpoint Affected	Classification
Water Flea *Daphnia magna*	99%	0.37 mg/L 0.54 mg/L	0.45 mg/L	428346-05 Putt 1993	growth (dry weight)	Core

[1] defined as the geometric mean of the NOAEC and the LOEC

Toxicity to Estuarine and Marine Animals

Estuarine and Marine Fish, Acute

An acute estuarine/marine fish early life-stage toxicity test using the TGAI is required for Etridiazole because the end-use product may be transported to a marine/estuarine environment from the intended use(turf) in coastal areas, the acute toxicity tests with the Etridiazole degradate (3-DCMT) resulted in an LC_{50} less than 1 mg/L, the pesticide is potentially persistent in water, *i.e.*, half life 81 - 83 days, and studies with other organisms indicate the reproductive physiology of invertebrates (daphnid NOEC = 0.37 mg/L) may be affected. Based on the results of a 96-hour acute toxicity test using sheepshead minnows (**Table 10**), Etridiazole is classified as moderately toxic to estuarine/marine fish. The guideline (72-3a) is fulfilled (MRID 428346-01).

Table 10. Summary of acute toxicity test on sheepshead minnow (*Cyprinodon variegatus*) for Etridiazole.

Species	% A. I.	LC_{50} mg/L	MRID No. Author/year	Toxicity Category	Classification
Sheepshead minnow	99%	4.0	428346-01 Machado 1993	moderately toxic	Core

Estuarine and Marine Invertebrates, Acute

Acute toxicity testing with estuarine/marine invertebrates using the TGAI is required for Etridiazole because the active ingredient is expected to reach this environment because of its use (turf) in coastal areas. Acute marine/estuarine toxicity studies were conducted on the Eastern oyster (*Crassostrea virginica;* Guideline 72-3b) and the mysid shrimp (*Mysidopsis bahia;* Guideline 72-3c). Results from these studies (**Table 11**) indicate similar estimates of toxicity for both species, *i.e.*, the NOEC was 0.94 mg/L for oysters and 0.61 mg/L for mysid shrimp. The mysid shrimp study (MRID 428346-03) fulfills the guideline requirements. The oyster study (MRID 428346-02) is classified as supplemental based on precipitate in the three highest test concentration dilution cells. Typically, water samples should be centrifuged prior to analysis when precipitate is noted. However, since the precipitate was observed in the dilution cells and not in the exposure chambers and since analysis was conducted on exposure water collected from the aquarium and not from the dilution cell, mean-measured concentrations are assumed to be reflective of exposure conditions. Since the EC_{50} falls in the range of 1 to 10 mg/L, Etridiazole is categorized as moderately toxic to estuarine/marine invertebrates on an acute basis. The guideline (72-3c) is fulfilled.

Table 11. Estuarine/marine acute toxicity tests using the Eastern oyster (*Crassostrea virginica*) and Mysid shrimp (*Mysidopsis bahia*) for Etridiazole.

Species	% A. I.	EC_{50} mg/L	MRID No. Author/year	Toxicity Category	Classification
Eastern Oyster	99%	2.6 mg/L	428346-02 Dionne 1993	moderately toxic	Supplemental
Mysid Shrimp	99%	2.5 mg/L	428346-03 Machado 1993a	moderately toxic	Core

Toxicity to Plants

Aquatic Plants

Results of Tier II toxicity testing on the technical/TEP material are tabulated below (**Table 12**). Green algae were the most sensitive (EC_{50} 0.072 mg/L) aquatic plant. Vascular plants, *i.e.*, duck weed were the least sensitive (EC_{50} 8.0 mg/L) roughly two-orders of magnitude less than the most sensitive nonvascular plant green algae. In the study of green algae (*Kirchneria subcapitata*; MRID 428346-06), the NOAEC and LOEC were 0.002 and 0.008 mg/L, respectively. In the blue-green algae (*Anabaena flos-aquae*; MRID 428346-07) the NOAEC and LOEC were 0.056 mg/L and 0.12 mg/L, respectively. In the diatom (*Navicula pelliculosa;* MRID 428346-08) the NOEC and LOEC were 0.007 mg/L and 0.02 mg/L, respectively. In *Skeletonema costatum* (MRID 428346-09) the NOEC and LOEC were 0.011 mg/L and 0.26 mg/L, respectively. Studies using duck weed (MRID 428346-10) resulted in an NOEC and LOEC or 1.4 mg/L and 2.9 mg/L, respectively. All of the studies except that involving duck weed were classified as core; however, the study on *L. gibba* was classified as supplemental since less than 11% of the original concentration of test material remained through the study and since no solvent controls were included. The guideline (122-2) is fulfilled.

Table 12. Nontarget Aquatic Plant Toxicity (Tier II) for Etridiazole

Species	% A. I.	EC_{50} mg/L	MRID No. Author/year	Classification
Kirchneria subcapitata	99%	0.072 mg/L	428346-06 Hoberg 1993a	Core
Anabaena flos-aquae	99%	0.26 mg/L	428346-07 Hoberg 1993b	Core
Navicula pelliculosa	99%	0.43 mg/L	428346-08 Hoberg 1998c	Core
Skeletonema costatum	99%	0.34 mg/L	428346-09 Hoberg 1998d	Core
Lemna gibba	99%	8.1 mg/L	428346-10 Hoberg 1998e	Supplemental

APPENDIX 5 EXPOSURE AND RISK CHARACTERIZATION

Risk assessment integrates the results of the exposure and ecotoxicity data to evaluate the likelihood of adverse ecological effects. The means of this integration is called the quotient method. Risk quotients (RQs) are calculated by dividing exposure estimates, *i.e.*, estimated environmental concentrations (EECs), by acute and chronic ecotoxicity values.

$$RQ = \text{EXPOSURE/TOXICITY}$$

RQs are then compared to OPP's levels of concern (LOCs). These LOCs are used by OPP to analyze potential risk to nontarget organisms and the need to consider regulatory action. The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on nontarget organisms. LOCs currently address the following risk presumption categories: (1) **acute high** -- potential for acute risk is high; regulatory action may be warranted in addition to restricted use classification, (2) **acute restricted use** -- the potential for acute risk is high, but may be mitigated through restricted use classification, (3) **acute endangered species** - endangered species may be adversely affected, and (4) **chronic risk** - the potential for chronic risk is high, regulatory action may be warranted. Currently, EFED does not perform assessments for chronic risk to plants, acute or chronic risks to nontarget insects, or chronic risk from granular/bait formulations to birds or mammals.

Risk presumptions and the corresponding RQs and LOCs, are tabulated below.

Table 1. Risk presumptions for terrestrial animals based on risk quotients (RQ) and levels of concern (LOC).

Risk Presumption	RQ	LOC
	Birds	
Acute High Risk	EEC[1]/LC_{50} or LD_{50}/ft^2 or LD_{50}/day[3]	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day	0.1
Chronic Risk	EEC/NOAEC	1
	Wild Mammals	
Acute High Risk	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day	
Chronic Risk	EEC/NOAEC	1

[1] abbreviation for Estimated Environmental Concentration (ppm) on avian/mammalian food items

[2] mg/ft^2

[3] mg of toxicant consumed/day

LD_{50} * wt. of bird LD_{50} * wt. of bird

Table 2. Risk presumptions for aquatic animals based on risk quotients (RQ) and levels of concern (LOC).

Risk Presumption	RQ	LOC
Acute High Risk	EEC[1]/LC_{50} or EC_{50}	0.5
Acute Restricted Use	EEC/LC_{50} or EC_{50}	0.1
Acute Endangered Species	EEC/LC_{50} or EC_{50}	0.05
Chronic Risk	EEC/MATC or NOAEC	1

[1] EEC = (ppm or ppb) in water

Table 3. Risk presumptions for plants based on risk quotients (RQ) and levels of concern (LOC).

Risk Presumption	RQ	LOC
Terrestrial and Semi-Aquatic Plants		
Acute High Risk	EEC[1]/EC_{25}	1
Acute Endangered Species	EEC/EC_{05} or NOAEC	1
Aquatic Plants		
Acute High Risk	EEC[2]/EC_{50}	1
Acute Endangered Species	EEC/EC_{05} or NOAEC	1

[1] EEC = lbs ai/A
[2] EEC = (ppb/ppm) in water

Exposure and Risk to Nontarget Terrestrial Animals

Birds

The acute and chronic risk quotients for broadcast applications of nongranular products (**Table 4**) indicate that for a single broadcast application of nongranular products, avian acute high, restricted use, and endangered species levels of concern are exceeded following single applications at 3.8 lbs a.i./A on short grass. Avian restricted use and endangered species levels of concern are exceeded following single application of 3.8 lbs. a.i./A on tall grass and broadleaf plants/insects food items. The avian chronic level of concern is exceeded at 0.38 lbs a.i./acre for short grass; at the registered maximum application rate equal to or above 3.8 lbs a.i./A, chronic avian LOCs are exceeded for short grass, tall grass and broadleaf plants/insects.

Table 4. Avian acute and chronic risk quotients for single application of nongranular products (broadcast) based on a mallard duck LC_{50} of 1,650 ppm and a mallard duck NOEC of 50 ppm.

Site/App. Method	App. Rate (lbs ai/A)	Food Items	Max. EEC (ppm)	Avg. EEC (ppm)	LC_{50} (ppm)	NOEC (ppm)	Acute RQ (EEC/LC_{50})	Chronic RQ	
								RQ (Max. EEC/NOEC)	RQ (56-day EEC/NOEC)
Cotton/ ground soil incorp.	0.38	Short grass	91	56	1,650	50	0.06	1.82[c]	1.12[c]
		Tall grass	42	25	1,650	50	0.03	0.84	0.5
		Broadleaf plants/ Insects	51	30	1,650	50	0.03	1.02[c]	0.6
		Seeds	6	3	1,650	50	<0.01	0.12	0.06
Turf/ ground unincorp	3.8	Short grass	912	557	1,650	50	0.55[a]	18.2[c]	11.1[c]
		Tall grass	418	250	1,650	50	0.25[b]	8.36[c]	5.0[c]
		Broadleaf plants/ Insects	513	301	1,650	50	0.31[b]	10.3[c]	6.02[c]
		Seeds	57	33	1,650	50	0.03	1.14[c]	0.66

[a] exceeds acute high, acute restricted and acute endangered species LOCs.
[b] exceeds acute restricted and acute endangered species LOCs.
[c] exceeds chronic LOC.

The acute and chronic risk quotients for multiple broadcast applications of nongranular products (**Table 5**) indicate that avian acute high risk, restricted use and endangered species levels of concern are exceeded following two applications of 3.8 lbs. a.i./A for birds feeding on short grass and broadleaf plants/insects. Acute restricted use and endangered species LOCs are exceeded for birds feeding on tall grass following two applications of 3.8 lbs. a.i./A. At the highest application rate, i.e., 5 applications of 3.8 lbs a.i./A, acute high risk, restricted use and endangered species LOCs are exceeded for birds feeding on all food items except

Chronic risk quotients can be calculated based on the average residues on food items. Average residues result from the pesticide being applied repeatedly, but degrading over the course of time from the first application to the last application. Avian chronic risk quotients (**Table 5**) based on average residues for multiple, broadcast applications of non-granular products indicate that the chronic LOC is exceeded for multiple applications ($\geq$ 2) of 3.8 lbs a.i./A for all food items.

Table 5. Avian acute and chronic risk quotients for multiple applications of nongranular products (broadcast) based on a mallard duck LC_{50} of 1,650 ppm and a mallard duck NOEC of 50 ppm.

Site/App. Method	App.Rate (lbs ai/A) No. of Apps.	Food Items	Max. EEC[e] (ppm)	Avg. EEC (ppm)	LC_{50} (ppm)	NOEC (ppm)	Acute RQ (EEC/LC_{50})	Chronic RQ	
								(max. EEC/NOEC)	(avg. EEC/NOEC)
Turf / ground unincorp	3.8 (2)	Short grass	1,660	1,053	1,650	50	1.0[a]	33[c]	21[c]
		Tall grass	761	481	1,650	50	0.46[b]	15[c]	9.6[c]
		Broadleaf plants/ Insects	934	588	1,650	50	0.57[a]	19[c]	12[c]
		Seeds	104	65	1,650	50	0.06	2.1[c]	1.3[c]
Turf / ground unincorp	3.8 (5)	Short grass	3,190	2036	1,650	50	1.93[a]	64[c]	41[c]
		Tall grass	1,462	945	1,650	50	0.89[a]	29[c]	19[c]
		Broadleaf plants/ Insects	1,795	1,173	1,650	50	1.09[a]	36[c]	23[c]
		Seeds	199	132	1,650	50	0.12[c]	4.0[c]	2.6[c]

[a] exceeds acute high, acute restricted and acute endangered species LOCs.
[b] exceeds acute restricted and acute endangered species LOCs.
[c] exceeds acute endangered species LOCs.
[d] exceeds chronic LOC.
[e] assumes degradation using FATE program.

Birds may be exposed to granular pesticides ingesting granules when foraging for food or grit. They also may be exposed by other routes, such as by walking on exposed granules or drinking water contaminated by granules. The number of lethal doses (LD_{50}) that are available within one square foot immediately after application ($LD_{50}s/ft^2$) is used as the risk quotient for granular/bait products. Risk quotients are calculated for three separate weight class of birds: 1,000 g (*e.g.*, waterfowl), 180 g (*e.g.*, upland gamebird), and 20 g (*e.g.*, songbird).

The acute risk quotients for broadcast applications of granular products (**Table 6)** indicate that avian acute high risk, restricted use, and endangered species LOCs are exceeded at the registered maximum application rate of 3.8 lbs ai/acre for songbirds, *i.e.*, body weight 20 g.. Acute restricted use and endangered species LOCs are exceeded for gamebirds, *i.e.*, body weight 180 g..

Table 6. Avian acute risk quotients for granular products (broadcast) based on a bobwhite quail LD_{50} of 560 mg/kg.

Site/ Application Method/Rate in lbs ai/A	% (decimal) of Pesticide Left on the Surface	Body Weight (g)	Exposed (mg/ft^2)	LD_{50}* (mg/kg)	Acute RQ[1] (LD_{50}/ft^2)
Turf/Unincorporated					
3.80	1.00	Songbird (20.00)	39.57	11.20	3.53[a]
3.80	1.00	Gamebird (180.00)	39.57	100.80	0.39[b]
3.80	1.00	Waterfowl (1,000.00)	39.57	560.00	0.07

[a] exceeds acute high, acute restricted and acute endangered species LOCs.
[b] exceeds acute restricted and acute endangered species LOCs.
[C] RQ = [App. Rate (lbs ai/A) * (453,590 mg/Lbs/43,560 ft^2/A)0.01]÷[LD_{50} mg/kg * Weight of Animal (g)/1000 g/kg] thus,
3.8 lbs ai/A * 453,590 mg/lbs ÷ 43,560 ft^2/A = 39.569 mg/ft^2
* weighted LD_{50}

The acute risk quotients for banded or in-furrow applications of granular products (**Table 7**) indicate that for banded/in-furrow applications of granular products no LOC is exceeded for birds.

Table 7. Avian acute risk quotients for granular products (in-furrow) based on a bobwhite quail LD_{50} of 560 mg/kg.

Site/Method		Bird Type and Body Weight (g)	% (decimal) of Pesticide Left on the Surface	Exposed mg/ft^2	LD_{50} * (mg/kg)	Acute RQ[1] (LD_{50}/ft^2)
Band Width (ft)	oz. ai per 1000 ft of Row					
Cotton/in-furrow(Incorporated)						
3.3	0.3	Songbird (20 g)	0.01	0.03	11.2	<0.01
3.3	0.3	Upland Gamebird (180 g)	0.01	0.03	100.8	<0.01
3.3	0.3	Waterfowl (1,000 g)	0.01	0.03	560	<0.01

[1] RQ =[(oz. ai per 1000 ft.* 28349 mg/oz) * 0.01 / bandwidth (ft) * 1000 ft] ÷[LD_{50}(mg/kg) * Weight of the Animal (g) ÷1000 g/kg]
* weighted LD_{50}

Mammals

Estimating the potential for adverse effects to wild mammals is based upon EEB's draft 1995 SOP of mammalian risk assessments and methods used by Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994). The concentration of Etridiazole in the diet that is expected to be acutely lethal to 50% of the test population (LC_{50}) is determined by dividing the LD_{50} value (usually rat LD_{50}) by the % (decimal of) body weight consumed. A risk quotient is then determined by dividing the EEC by the derived LC_{50} value. Risk quotients are calculated for three separate weight classes of mammals (15, 35, and 1000 g), each presumed to consume four different kinds of food (grass, forage, insects, and seeds). Acute risk quotients for broadcast applications of nongranular products (**Table 8** and **Table 9**) indicate that acute high risk, restricted use, and endangered species LOCs are exceeded for small and intermediate-sized mammals feeding on short grasses; acute restricted use and endangered species LOCs are exceeded for small and intermediate-sized mammals feeding on tall grasses and

broadleaf plants/insects. Acute endangered species LOCs were exceeded for large-sized mammals feeding on short grasses. No LOC was exceeded for granivores (**Table 9**).

Table 8. Mammalian (herbivore/insectivore) acute risk quotients for single application of nongranular products (broadcast) based on a (rat) LD_{50} of 1,028 mg/kg.

Site/ Application Method/ Rate in lbs ai/A	Body Weight (g)	% Body Weight Consumed	Rat LD_{50} (mg/kg)	EEC (ppm) Short Grass	EEC (ppm) Tall Grass	EEC (ppm) Broadleaf plants/insects	Acute RQ[a] Short Grass	Acute RQ Tall Grass	Acute RQ Broadleaf plants/insects
Turf/ground									
3.8	15	95	1,028	912	418	513	0.84[b]	0.39[c]	0.47[c]
3.8	35	66	1,028	912	418	513	0.59[b]	0.27[c]	0.33[c]
3.8	1,000	15	1,028	912	418	513	0.13[d]	0.06	0.07

[a] RQ = $\frac{\text{EEC (ppm)}}{\text{LD50 (mg/kg)/ \% Body Weight Consumed}}$

[b]Acute high, restricted and endangered species LOCs exceeded.

[c]Acute restricted and acute endangered species LOCs exceeded.

[d]Acute endangered species LOC exceeded.

Table 9. Mammalian (granivore) acute risk quotients for single application of nongranular products (broadcast) based on a (rat) LD_{50} of 1,028 mg/kg.

Site Application Method/Rate in lbs ai/A	Body Weight (g)	% Body Weight Consumed	Rat LD_{50} (mg/kg)	EEC (ppm) Seeds	Acute RQ[1] Seeds
Turf/ground					
3.8	15	21	1,028	57	0.01
3.8	35	15	1,028	57	0.01
3.8	1000	3	1,028	57	0.00

[1] RQ = $\frac{\text{EEC (ppm)}}{\text{LD}_{50}\text{ (mg/kg)/ \% Body Weight Consumed}}$

Acute risk quotients for multiple applications on nongranular products (**Table 10** and **Table 11**) indicate that at the typical application rate (2 applications of 3.8 lbs a..i./A) to turf, acute high risk, restricted use and endangered species LOCs are exceeded for small and intermediate-sized mammals feeding on short grasses and broadleaf plants/insects, as well as for small-sized animals feeding on short grasses. Acute restricted use and endangered species LOCs were exceeded for large mammals feeding on short grasses and intermediate-sized animals feeding on tall grasses. Acute endangered species LOCs were exceeded for large-sized animals feeding on both tall grasses and broadleaf plants/insects. At the maximum application rate for tees and greens, acute high risk, restricted use and endangered species LOCs are exceeded for small and intermediate-sized mammals feeding on short grass, tall grass and broadleaf plants/insects. Acute restricted use and endangered species LOCs are exceeded for large-sized mammals feeding on short grass, tall grass and broadleaf plants/insects. No LOCs were exceeded for granivores following either of the multiple broadcast applications scenarios presented in **Table 11**.

Table 10. Mammalian (herbivore/insectivore) acute risk quotients multiple applications of nongranular products (broadcast) based on a (rat) LD_{50} of 1,028 mg/kg.

Site/ App. Method/ Rate in lbs ai/A (No. of Apps.)	Body Weight (g)	% Body Weight Consumed	Rat LD_{50} (mg/kg)	EEC (ppm) Short Grass	EEC (ppm) Tall Grass	EEC (ppm) Broadleaf plants/ insects	Acute RQ[1] Short Grass	Acute RQ Tall Grass	Acute RQ Broadleaf plants/ insects
Turf/ground									
3.8 (2)	15	95	1,028	1,660	761	934	1.53[b]	0.70[b]	0.86[b]
3.8 (2)	35	66	1,028	1,660	761	934	1.07[b]	0.49[c]	0.60[b]
3.8 (2)	1,000	15	1,028	1,660	761	934	0.24[c]	0.11[d]	0.14[d]
Turf (tees and greens) /ground									
3.8 (5)	15	95	1,028	3,190	1,462	1,795	2.95[b]	1.35[b]	1.66[b]
3.8 (5)	35	66	1,028	3,190	1,462	1,795	2.05[b]	0.94[b]	1.15[b]
3.8 (5)	1,000	15	1,028	3,190	1,462	1,795	0.47[c]	0.21[c]	0.26[c]

[a] $RQ = \frac{EEC\ (ppm)}{LD_{50}\ (mg/kg)/\ \%\ Body\ Weight\ Consumed}$

[b]Acute high, restricted and endangered species LOCs exceeded.

[c]Acute restricted and acute endangered species LOCs exceeded.

[d]Acute endangered species LOC exceeded.

Table 11. Mammalian (grainivore) acute risk quotients for multiple applications nongranular products (broadcast) based on a (rat) LD_{50} of 1,028 ppm.

Site/ App. Method/ Rate in lbs ai/A (No. of Apps.)	Body Weight (g)	% Body Weight Consumed	Rat LD_{50} (mg/kg)	EEC (ppm) Seeds	Acute RQ[a] Seeds
Turf/ground					
3.8(2)	15	21	1,028	104	0.02
3.8(2)	35	15	1,028	104	0.02
3.8(2)	1,000	3	1,028	104	<0.01
Turf/ground					
3.8(5)	15	21	1,028	199	0.04
3.8(5)	35	15	1,028	199	0.03
3.8(5)	1,000	3	1,028	199	0.01

[1] [a]$RQ = \frac{EEC\ (ppm)}{LD_{50}\ (mg/kg)/\ \%\ Body\ Weight\ Consumed}$

Mammalian species also may be exposed to granular/bait pesticides by ingesting granules. They also may be exposed by other routes, such as by walking on exposed granules and drinking water contaminated by granules. The number of lethal doses (LD_{50}'s) that are available within one square foot immediately after application can be used as a risk quotient (LD_{50}'s/$ft^{2)}$ for the various types of exposure to bait pesticides. Risk quotients are calculated for three separate weight classes of mammals: 15 g, 35 g and 1,000 g.

The acute risk quotients for broadcast applications of granular products (**Table 12**) indicate that for

broadcast granular products, mammalian acute high risk, restricted use, and endangered species LOCs are exceeded at a registered maximum application rate equal to or above 3.8 lbs a.i./acre. Currently, EFED does not have a standard procedure for assessing chronic risk to mammalian species for granular products.

Table 12. Mammalian acute risk quotients for granular products (broadcast) based on a rat LD_{50} of 1,028 mg/kg.

Site/ Application Method/ Rate in lbs ai/A	% (decimal) of Pesticide Left on the Surface	Body Weight (g)	Rat LD_{50} (mg/kg)	Acute RQ[1] ($LD50/ft^2$)
Turf/ground				
3.8	1.0	15	1,028	2.56[2]
3.8	1.0	35	1,028	1.10[2]
3.8	1.0	1,000	1,028	0.04

[1] RQ = $\frac{\text{App. Rate (lbs ai/A) * (453,590 mg/lbs/43,560 ft}^2\text{/A)}}{\text{LD50 mg/kg * Weight of Animal (g) * 1000 g/kg}}$

[2] Acute high, restricted use and endangered species LOCs exceeded.

The acute risk quotients for banded or in-furrow applications of granular products are tabulated below (**Table 13**). The results indicate that for banded/in-furrow granular products, no mammalian acute levels of concern are exceeded at any registered application rate.

Table 13. Mammalian acute risk quotients for granular products (banded or in-furrow) based on a rat LD_{50} of 1,028 mg/kg.

Site/Method Band Width (feet)	oz. ai.1000 ft of row	Body Weight (kg)	% (decimal) of Pesticide Left on the Surface	Exposed mg/ft^2	Rat LD_{50} (mg/kg)	Acute RQ[1] ($LD50/ft^2$)
Cotton/in-furrow (Incorporated)						
0.5	0.14	15	0.15	1.19	1028	0.08
0.5	0.14	35	0.15	1.19	1028	0.03
0.5	0.14	1000	0.15	1.19	1028	0.00

[1] RQ = $\frac{\text{oz. ai per 1000 ft.* 28349 mg/oz * \% Unincorporated / bandwidth (ft) * 1000 ft}}{\text{LD50(mg/kg) * Weight of the Animal (g) * 1000 g/kg}}$

Exposure and Risk to Nontarget Freshwater Aquatic Animals

Initially, EFED calculates EECs using the GENeric Expected Environmental Concentration Program (GENEEC). The EECs are used for assessing acute and chronic risks to aquatic organisms. Acute risk assessments are performed using either 0-day EEC values for single application or peak EEC values for multiple application. Chronic risk assessments are performed using the 21-day EECs for invertebrates and 56-day EECs for fish.

EFED also uses environmental fate and transport computer models to calculate refined EECs. The Pesticide Root Zone Model (PRZM2) simulates pesticides in field runoff. The Exposure Analysis Modeling System (EXAMII) simulates pesticide fate and transport in an aquatic environment (one hectare body of water, two meters deep).

Based on the proposed application site and method (summarized below) the estimated aquatic environmental concentrations were derived using Tier I GENEEC (**Table 14**). Typical application rates to turf resulted in the highest initial estimated environmental concentrations (228 ppm); the EEC for turf was roughly two orders of magnitude greater than the EEC following applications to either seeds or cotton. At the maximum application rate for tees and greens, *i.e.*, 5 applications at 3.8 lbs a.i./A, EECs peaked at 437 ppb, roughly double the EEC from typical applications to turf.

Table 14. Predicted initial, 21-day and 56-day aquatic estimated environmental concentrations (EECs) for Etridiazole by application site and method.

Site	Application Method	Application Rate (lbs ai/A)	# of Apps./ Interval Between Apps.	Initial (PEAK) EEC (ppb)	21-day EEC (ppb)	56-day EEC (ppb)
GENEEC						
Cotton	Ground incorporated (2", in furrow)	0.38	1 (at planting)	6.13	5.45	4.54
Turf (golf course)	Ground unincorporated	3.8	2 (10 d.)	228	203	169
Turf (tees and greens)	Ground unincorporated	3.8	5(10 d.)	437	389	324
Seed treatment	Ground incorporated (1", in furrow)	0.001	1 (at planting)	0.031	0.028	0.023

Freshwater Fish

Acute and chronic risk quotients are tabulated below (**Table 15**). The results indicate that aquatic restricted use and endangered species levels of concern are exceeded for freshwater fish at a registered application rate equal to or above 3.8 lbs./A. The chronic risk level of concern is exceeded for freshwater fish at a registered application rate equal to or above 3.8 lbs/A

Table 15. Risk quotients for freshwater fish based on a rainbow trout 216-hr LC_{50} of 1,200 ppb and a rainbow trout NOEC of 120 ppb.

Site/ Application Method	Rate in lbs as/A (No. of Apps.)	LC_{50}* (ppb)	NOEC/ (ppb)	EEC Initial/ Peak (ppb)	EEC 56-Day Average	Acute RQ (EEC/LC_{50})	Chronic RQ (EEC/NOEC)
Cotton/ground, soil incorp.	0.38 (1)	1,210	120	6.13	4.54	0.005	0.04
Turf/ground unincorp.	3.8 (2)	1,210	120	228	169	0.188[a]	1.41[c]
Turf (tees and greens) ground unincorp.	3.8 (5)	1,210	120	437	324	0.361[a]	2.70[c]
Seed/ treatment	0.001(1)	1,210	120	0.031	0.023	<0.01	<0.01

[a] exceeds acute restricted and acute endangered species LOCs.
[b] exceeds chronic LOC.

Freshwater Invertebrates

The acute and chronic risk quotients are tabulated below (**Table 16**). The results indicate that aquatic acute endangered species levels of concern are exceeded for freshwater invertebrates at a registered maximum application rate equal to or above 3.8 lbs/A. At the maximum application rate to tees and greens, chronic LOCs were exceeded.

Table 16. Risk quotients for freshwater invertebrates based on a daphnids EC_{50} of 4,900 ppb and a daphnid NOEC of > 370 ppb.

Site/ Application Method	Rate in lbs as/A (No. of Apps.)	LC_{50} (ppb)	NOEC/ MATC (ppb)	EEC Initial/ Peak (ppb)	EEC 21-Day Average	Acute RQ (EEC/LC_{50})	Chronic RQ (EEC/NOEC or MATC)
Cotton/ground, soil incorp.	0.38 (1)	4900	370	6.13	5.45	0.00	0.01
Turf/ground unincorp.	3.8 (2)	4900	370	228	202	0.05[a]	0.55
Turf (tees and greens)/ground unincorp.	3.8 (5)	4900	370	437	389	0.09[a]	1.05[b]
Seed/ treatment	0.001(1)	4900	370	0.031	0.028	0.00	0.00

[a] exceeds acute endangered species LOCs.
[b]exceeds chronic LOC

Estuarine and Marine Animals

The acute and chronic risk quotients for estuarine/marine fish are tabulated below (**Table 17**). The results indicate that the acute endangered species level of concern was exceeded for estuarine fish at the typical application rate for turf; however, at the maximum application rate for tees and greens, acute restricted use LOCs are exceeded.

Table 17. Risk Quotients for estuarine/marine fish based on a sheepshead minnow LC_{50} of 4,000 ppb.

Site/ Application Method	Rate in lbs ai/A (No. of Apps.)	LC_{50} (ppb)	EEC Initial/ Peak (ppb)	EEC 56-Day Average	Acute RQ (EEC/LC_{50})
Cotton/ground, soil incorp.	0.38 (1)	4,000	6.13	4.54	0.00
Turf/ground unincorp.	3.8 (2)	4,000	228	169	0.06[b]
Turf (tees and greens)/ground unincorp.	3.8 (5)	4,000	437	324	0.11[a]
Seed/ treatment	0.001(1)	4,000	0.031	0.028	0.00

[a]exceeds acute restricted use LOCs
[b] exceeds acute endangered species LOCs.

The acute risk quotient for estuarine/marine invertebrates are tabulated below (**Table 18**). The results indicate that aquatic acute endangered species levels of concern are exceeded for estuarine invertebrates at typical application rate for turf and acute restricted use LOCs are exceeded at the maximum application rate for tees and greens. No data were available to determine the chronic risk

to estuarine/marine invertebrates.

Table 18. Risk quotients for estuarine/marine aquatic invertebrates based on a mysid shrimp EC_{50} of 2500 ppb.

Site/ Application Method	Rate in lbs ai/A (No. of Apps.)	LC_{50} (ppb)	EEC Initial/ Peak (ppb)	Acute RQ (EEC/LC_{50})
Cotton/ground, soil incorp.	0.38 (1)	2,500	6.13	<0.01
Turf/ground unincorp.	3.8 (2)	2,500	228	0.09[b]
Turf (tees and greens)/ground unincorp.	3.8 (5)	2,500	437	0.18[a]
Seed/ treatment	0.001(1)	2,500	0.031	<0.01

[A] exceeds acute restricted use LOCs
[b] exceeds endangered species LOCs.

Exposure and Risk to Nontarget Plants

Dry and semi-aquatic areas

Terrestrial plant testing is not currently required for fungicides.

Aquatic Plants

Exposure to nontarget aquatic plants may occur through runoff or spray drift from adjacent treated sites or directly from such uses as aquatic weed or mosquito larvae control. An aquatic plant risk assessment for acute high risk is usually made for aquatic vascular plants from the surrogate duckweed *Lemna gibba*. Non-vascular acute high aquatic plant risk assessments are performed using either algae or a diatom, whichever is the most sensitive species. An aquatic plant risk assessment for acute endangered species is usually made for aquatic vascular plants using duckweed. To date there are no known non-vascular plant species on the endangered species list. Runoff and drift exposure is computed from GENEEC. The risk quotient is determined by dividing the pesticide's initial or peak concentration in water by the plant EC_{50} value.

Acute risk quotients for vascular (*L. gibba*) and non-vascular plants are tabulated below (**Table 19**). The results indicate that plant acute levels of concern are exceeded for non-vascular aquatic plants at both the typical (2 applications) and maximum (5applications) rate for turf of 3.8 lbs/A. At the maximum application rate for cotton, *i.e.*, 0.38 lbs/A, the endangered species LOC is exceeded.

Table 19. Acute risk quotients for aquatic plants based upon a duckweed (*Lemna gibba*) EC_{50} of 8,000 ppb ai and a nonvascular plant *(Kirchenaria subcapitata*) EC_{50} of 72 ppb ai. For endangered species, the NOAEC for *L. gibba* and *K. subcapitata* were 1,400 and 2 ppb, respectively.

Site/ Application Method/ Rate of Application (lbs ai/A)	Species	EC_{50} (ppb)	EEC (ppb)	NOEC (ppb)	Endangered Species RQ (EEC/NOEC)	Non-target plant RQ (EEC/EC_{50})
Turf 3.8 (2) ground unicorporated	*L. gibba*	8,000	228	1400	0.16	0.03
	K. subcapitata	72	228	2	114[a]	3.2[a]
Turf (tees and greens) 3.8(5) ground unincorporated	*L. gibba*	8,000	437	1400	0.31	0.06
	K. subcapitata	72	437	2	218[a]	6.1[a]
Cotton 0.38 (1) ground incorporate	*L. gibba*	8,000	2.3	1400	<0.01	<0.01
	K. subcapitata	72	2.3	2	1.15[a]	0.03

[a] exceeds acute high and acute endangered species LOCs.

APPENDIX 6 REFERENCES

Dieterich, W. H.. 1965. Acute aqueous exposure–fish: Terrachlor Super X. Hazleton Laboratories Report #791-101. Percent active ingredient unknown. Reviewed by J. T. Tice (EPA). Rainbow trout LC_{50} 2.52 mg/L; bluegill sunfish LC_{50} 9.0 mg/L; goldfish LC_{50} 10 mg/L. Supplemental since formulated product was tested. MRID 00001572.

Dieterich, W. H. 1965. Acute dietary administration (8-day)-waterfowl: Terrachlor Super X. Hazleton Laboratories Report #791-100. Super X composed of 23% Terrachlor and 12% Etridiazole. Mallard duck LC_{50} > 21,500 ppm; bobwhite quail LC_{50} > 17,800 ppm. Supplemental since formulated product was tested. MRID 00002226.

Dionne, E. 1993. Etridiazole technical: acute toxicity to the Eastern oyster (*Crassostrea virginica*) under flow-through conditions. Springborn Laboratories Report #93-2-4650. Reviewed by T. M. Steeger and R. Lee (EPA). EC_{50} 2.88 mg/L; NOEC 0.94 mg/L. Supplemental, however, study need not be repeated. Improper analytical procedure to determine mean-measured concentrations when precipitate is present. MRID 428346-02.

Fletcher, D. 1972. Acute oral toxicity study with Olin Etridiazole in mallard ducks. Industrial Bio-Test Laboratories Report #J891. Reviewed by J. T. Rice (EPA). Percent active ingredient 95 - 97% (formulation 12– emulsifiable concentrate). Avian acute oral LD_{50} 1,640 mg/kg. Supplemental; test does not satisfy guideline requirements due to missing information regarding material tested, test procedure and lack of concurrent controls. MRID 00002238.

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428346-06.

Hoberg, J. R.. 1993b. Etridiazole technical: toxicity to the freshwater blue-green algae, *Anabaena flos-aquae*. Springborn Laboratories Report #93-3-4710. Reviewed by T. M. Steeger and R. Lee (EPA). EC_{50} 0.26 mg/L; NOEL 0.056 mg/L. Core. MRID 288346-07.

Hoberg, J. R. 1993c. Etridiazole technical: toxicity to the freshwater diatom, *Navicula pelliculosa*. Springborn Laboratories Report #93-5-4763. Reviewed by T. M. Steeger and R. Lee (EPA). EC_{50} 0.43 mg/L; NOEC 0.0067 mg/L. Core. MRID 428346-08.

Hoberg, J. R. 1993d. Etridiazole technical: toxicity to the marine diatom, *Skeltonema costatum*. Springborn Laboratories Report #93-4-4742. Reviewed by T. M. Steeger and R. Lee (EPA). EC_{50} 0.34 mg/L; NOEC 0.011 mg/L. Core. MRID 428346-09.

Hoberg, J. R. 1993e. Etridiazole technical: toxicity to the duck weed, *Lemna gibba*. Springborn Laboratories Report #93-4-4714. Reviewed by T. M. Steeger and R. Lee (EPA). EC_{50} 8.0 mg/L; NOEL 1.4 mg/L. Core. MRID 428346-10.

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Machado, M. W. 1993. Etridiazole technical: the toxicity to rainbow trout (*Oncorhynchus mykiss*) during an early life stage exposure. Springborn Laboratories Report #93-5-4767. Reviewed by T. M. Steeger and R. Lee (EPA). NOEC 0.12 mg/L; LOEC 0.24 mg/L (larval weight); MATC 0.17 mg/L. Supplemental but can be upgraded to core if registrant demonstrates that neither pH nor water hardness affect the toxicity or solubility of Etridiazole.. MRID 428346-04.

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Pedersen, C. A. and A. M. Solatycki. 1995. Toxicity and reproduction study with Etridiazole technical in mallard ducks. Bio-Life Associate Report #109-022-08. M. Feken and P. Kosalwat, reviewers (KBN). Percent active ingredient 97.9%. NOEC 50 ppm; LOEC 350 ppm (eggs laid, eggs set, viable embryos, normal hatchlings and 14-day old survivors weight). MRID 437441-02.

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